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A NOVEL TYPE OF ROAD TRAIN.

By Dr. Alfred Gradenwitz.

An interesting eight-axle road train for an effective load of 15 tons has been recently designed by the Freibahn, Ltd., of Tegel, near Berlin. This comprises a symmetrical tractor locomotive with four driven wheels and two three-axle trailers, which are compelled by an automatic steering device always to adjust themselves radially to curves. The normal capacity of the train is 15 tons, and its speed 5 to 7 miles with full load and 7 to 8 miles with no load.

The working weight of the locomotive is about 11 tons, and the pressure on the axles accordingly, about 5.5 tons. Each trailer is 4 tons in weight, of which 1.2 tons corresponds with each external and about 1.6 tons with the central axle. As the effective load is 2.5 tons per axle, the maximum wheel pressure of the locomotive works out at 2.75 tons, that of the central trailer axle at 2.05 tons, and that of the external trailer axles at 1.85 tons each. The use of large wheels of considerable width is an advantageous feature. The treads of the trailer wheels are set at a slight angle to one another.

The locomotive comprises two single-axle parts, which are connected by a rotary bascule, a hand wheel in the driver's stand being used for steering. According to the direction of rotation of a spindle located in the front frame of the locomotive, this frame is thrown against the bascule in a right-hand or left-hand direction. A toothed-wheel gearing allows any deviation of the front axle of the locomotive to be transmitted to the rear axles at the same angle.

As explosive motors would have been too delicate to stand the rough handling in the case of heavy loads, steam is used for yielding the motive power, the steam generator being arranged on the front axle, and the water and oil stores on the rear axle. Tar oil, because of its high flash point and sparkless combustion, has

AT THE CREST OF A GRADE.

THE TRAIN IS CAPABLE OF NEGOTIATING HEAVY GRADES.

A NOVEL TYPE OF ROAD TRAIN.

been chosen as fuel, thus reducing the risk of fire. The burner, which merely consists of a steam and oil nozzle, is mounted on the front of the boiler, and is readily accessible from the outside. The steam and oil are mixed and the flame is formed in a conical funnel, which takes the place of the firebox, thereby effecting a regular air supply and uniform burning.

The normal steam pressure in the boiler is about 300 pounds. The boiler has been designed as a water-tube boiler, and accordingly has a large heating surface.

Each locomotive axle is driven by its own steam motor, which arrangement is doubtless preferable to the use of a coupling between the axles. Should one of the motors fail to work, the locomotive would be able to continue with the other. The motors can be readily interchanged, and are designed on the compound system. As the intermediary gearings from the motor to the driving wheels are likewise identical and interchangeable, the number of reserve parts is reduced to a minimum. A non-locking worm gearing is used as a main gearing, the teeth of the worm wheel being replaced by rollers of tooth-shape, so as to reduce the wear and tear, as well as the friction losses, to a minimum.

The differential gear fitted into the worm wheel insures a mutual independence of the rotation of the two driven wheels, mounted on the same axle, in traversing a curve.

A change-gear inserted between the motor and the worm gearing allows two different speeds to be used with the same number of turns of the motor, the higher speed being employed on good roads and the lower speed on heavy grades or in case of considerable loads.

A chain and chain-wheel arrangement is used for transmitting the motive power to the driving wheels. All the gears, except the chain drive, are mounted in oil, within tightly closed housings, ball bearings being used as far as possible. The driving wheels of the locomotive are of very simple design and are made of wrought iron, so as to be easily repaired. The wheels comprise alternate wooden and iron bands, insuring perfect adhesion, even on slippery or snowed-over roads. Special provision has further been made for traveling on roads covered with snow or ice, by fitting toothed segments bolted round the wheel. The water and oil are stored in separate and readily removable tanks on the second axle of the locomotive, only flexible tubes being used for connecting the two axles with one another.

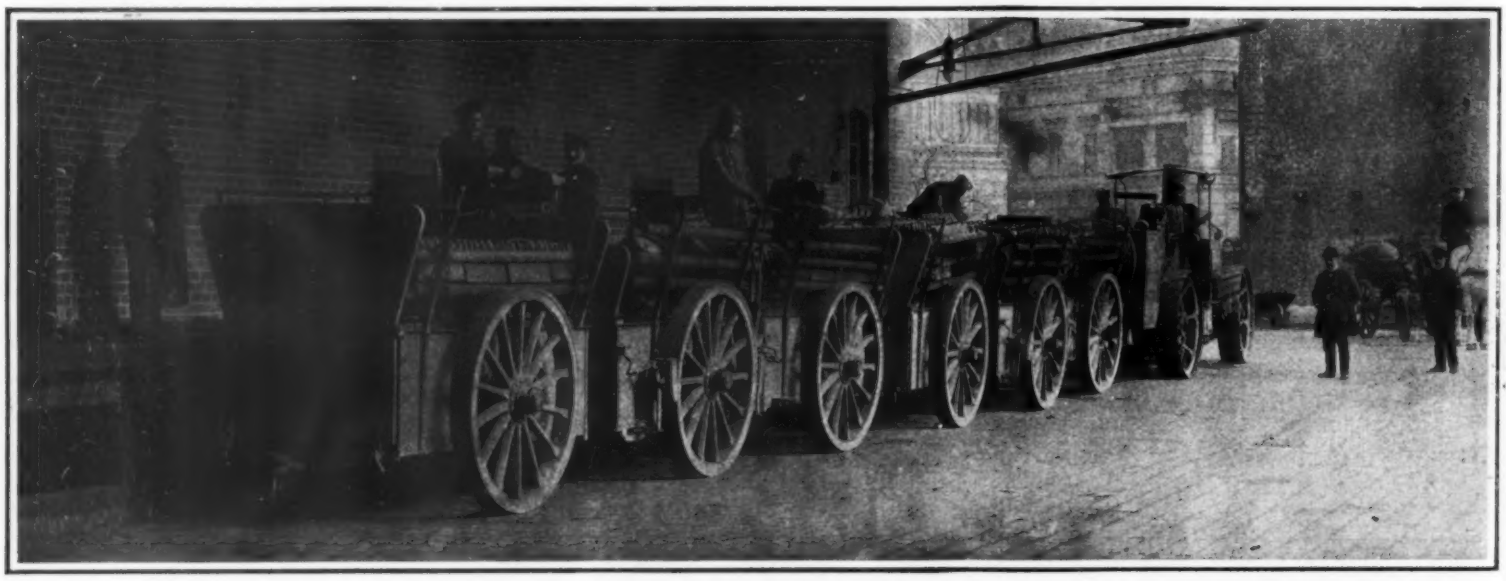
A condenser fitted in front of the water tank allows part of the exhaust steam to be utilized for the feeding of the boilers.

The two outer axles of each trailer are loosely connected with the central axle by bascules, rotating round the axle centers. The central axle is compelled by a special steering always to keep its radial adjustment. While the front axle is entirely disengaged, the rear axle, by means of a guide bolt, is compelled to adjust itself in a manner corresponding with the radial adjustment of the central axle. By loosening or fixing these guiding bolts, each of the outer axles can be disengaged or engaged at will with the central axle. The low position of the center of gravity insures extraordinary smooth running. The central axle is used as a braking axle, the self-locking spindle brake being operated from either side. The trailer wheels are made of wood with a view to reduce their weight, but are fitted with substantial iron rims. The minimum radius of curves which can be negotiated is 22 feet.

The full load of the train is readily transported on good roads up grades of 1:14. When the grades run from 1:10 and upward, the train is divided.

The water tank holds enough for a 20-mile run. The range of the oil supply is 60 miles.

The symmetrical design of the train has been found to be very convenient, allowing the locomotive to be placed with either of its ends at the head or rear of the train. The mutual connection of the trailer axles allows even very narrow street crossings to be dealt with.



LOADING THE CARS OF THE TRAIN.

A NOVEL TYPE OF ROAD TRAIN.

MYCOLYSINE.

THE question as to whether the duration of life can be increased is one which has been occupying the attention of scientists for some time past especially since the work of Prof. Metchnikoff of the Pasteur Institute. It is now sought to increase the length of the active period of existence by preserving the vitality of the body rather than by adding any greater number of years. Dr. Doyen, who is well known in Paris for his scientific work and his advanced ideas on these questions, has discovered a ferment principle which if it is not an "elixir of life," certainly has some remarkable properties. What he wished to accomplish was to prevent or at least to retard as much as possible the decay or aging of the body, and to have the system keep up its activity during the period of old age instead of falling into the decay which now characterizes this period.

Dr. Doyen commences by searching for the principal causes of the aging of the body, and in a recent paper he showed what were the agents which caused decay. These seem to be the continual self-poisoning, as we might call it, of our organism, and this is due to our food as well as to severe or light maladies which, even if cured, contribute to the poisoning of the system. It is natural to seek for a remedy for this self-poisoning, and Dr. Doyen believes that he has found it. He bases his method on the work by Prof. Metchnikoff. Following out Metchnikoff's idea of the perpetual struggle which goes on between the white globules of the blood and the microbes which invade the system, Dr. Doyen succeeds in obtaining new therapeutic substances which contain vital principles of great energy. These substances are derived from ferments and they possess the remarkable property of causing the production of leucocytes or white globules of the blood, and the destructive power upon the microbes is thus increased. By this means the organism is more strongly fortified and its vitality is greater. The microbes which seek to penetrate into our respiratory organs, the digestive tubes and into other parts of the body are destroyed by the leucocytes before they have an opportunity to cause an infection. The new liquid preparation which he has found by a series of researches is known as mycolysine, and it appears to have a marked effect in bringing about the destruction of the harmful microbes. One of the most practical effects which appear from its use is that of curing certain maladies within a very short time, and Dr. Doyen states that a simple coryza can be cured within half an hour if it is taken at the start. This preparation is able to prevent to some extent all of the diseases of the respiratory organs such as colds, bronchitis, pnuemonia and others of a like nature. A number of diseases of the digestive organs can also be prevented in the same way. Even in epidemic maladies such as diphtheria, these ferments can be used to cause an increase in the number of the white corpuscles, and the action of these latter upon the microbes is then stimulated by the anti-diphtheric serum of Roux and Behring. The conclusion drawn from this research seems to be that by defending the organism against numerous affections and by curing the diseases which occur, we avoid the action of self-poisoning of the system, or at any rate will lessen the number of such cases. In this way we are able to cause a lengthening of our active existence, and by so doing we may be said to practically lengthen the period of life.

MECHANICAL TRACTION ON TRAMWAYS AND ROADS.

MR. H. CONRADI recently read a paper before the Society of Engineers on mechanical traction. The origin of the tramways, about 200 years ago, consisted in the laying of straight and parallel pieces of timber from the colliery to the river, for the conveyance of coal. Later on, iron flat bars were fixed on the top of those sleepers, to increase the traction facilities, which gradually developed in the establishment of railways in about the year 1767. The idea of mechanical traction on common roads was, however, not abandoned, and, after a first trial in 1769, energetically revived between the years of 1803 to 1836, and periodically continued till about 1872, after which time they were obliged to stop running, on account of the imposition of oppressive taxes and other obstacles, on the part of the local authorities. This revived tramway traction; first by horse and then by mechanical power. Starting with some description of the first steam omnibus, the writer mentioned the construction of the engines and the different powers used, as steam, compressed air, gas, etc. This included the different methods of cable traction and the fireless engines. The use of steam had, however, never been allowed to develop fairly and firmly, and the local authorities seem to have done their best to hamper its service. Also the Tramway Act of 1870 proved a creation to the detriment of private enterprise.

This was followed by the introduction of electric traction, with its different methods by underground or slot-conduit, by surface-contact, and by overhead wire; the latter, being the cheapest in cost, was therefore more generally used. The author mentioned that in competition with tramway traction, on account of the permanent way construction, along the ordinary roads, mechanical traction on common roads was again thought of, seeming to be preferable, requiring no rails along the roads. It made rapid development, as now seen in the production of gasoline, steam, and electric motor omnibuses and private carriages. The use of the motor omnibuses especially, but also of the private carriages created, however, many unforeseen and unexpected evils, as destruction of the roads, unhealthy smells from burnt gasoline vapors, depreciation of property in town and country, the destructive nuisance of enormous dust waves, dangers to life of the public and many other grave difficulties. All these grave difficulties so detrimental to the public in general would have to be overcome, if mechanical traction on common roads is to become useful and beneficial to the public. The author then mentioned the necessity of consolidating the roads, and especially of finding means to prevent the raising of such tremendous dust waves, so destructive to all kinds of property in town and country. As to electric traction, the author said the destructive wave motion of the rails would have to be overcome. Details were

given of the different kinds of French, American, German, and English life-guards in use. Reviewing in conclusion the different methods of traction on tramways and common roads, the installations required in all the details for electric traction, those of motor omnibus garage, the very great number of breakdowns along all the roads, with permission by the local authorities to undertake temporary repairs on the road which was never permitted during steam tramway traction, properly conducted, seemed still to be capable of holding its own against electric and motor omnibus traction, under the same conditions and if the same facilities were given; cost of installation being less and cost of working being about the same, even rather less than more.

ELECTROLYTIC SHEETS AND TUBES.*

A PROCESS FOR THEIR DIRECT PRODUCTION.

BY SHERARD COWPER-COLES

ELECTROLYTIC iron can be obtained almost chemically pure when special precautions are taken, but even then, when the product is made to form the poles of an electric arc lamp and the spectrum is carefully examined, there is evidence of the presence of minute quantities of impurities.

Alfred Smee in his book on electro-metallurgy, printed in 1851, makes the following remarks: "The reduction of iron, from a pecuniary point of view, is the very worst process in the whole range of electric metallurgy, for the metal is scarcely worth anything in comparison with others. Ironmasters doubtless sleep in perfect security when they are told that from one equivalent of galvanic power derived from my battery, costing one-twentieth of a penny, 28 grains of iron are reduced, so that the reduction of 1 pound of iron, worth about a penny, would cost more than a shilling for the bare materials used in its production, added to the value of the metal. In this aspect of affairs not only the blast, but even the puddling and smelting furnaces, are likely to continue to send forth their pestiferous fumes by day and their pandemonium-looking flames by night, corrupting the atmosphere to the injury of vegetation as well as to the detriment of the health of human beings."

Since Alfred Smee made this remark forty-seven years ago great progress has been made, the cost having been reduced from over a shilling per pound for iron in a rough form, which required smelting and rolling, to 0.56 of a penny for iron obtained in a finished form capable of realizing the highest market value. Up to the present time the process of electro-deposition has been confined to the facing of engraved copper plates for fine printing, such as bank notes, as iron has the advantage of being easily removed with acid when worn through, thus enabling the iron facing to be removed without damage to the copper plate.

Some electrolytes for the deposition of iron are ferrous chloride, ferrous ammonium sulphate and magnesium sulphate, ferrous sulphate, iron sulpho-cresylate.

The voltage required for different electrolytes at varying temperatures and current densities is set forth in tabular form in the paper.

Sheets and tubes with a surface that required no after-treatment were first obtained in 1908.

To produce electrolytic iron commercially, the voltage between the terminals of the depositing cell must be low, the current density per square foot of cathode surface must be high, and the iron or steel deposited must be in such a form that it can be used for industrial purposes without smelting.

The process consists briefly in placing crude iron (which may contain those elements which are at present detrimental to the production of high-class iron or steel), or finely-divided iron ore, in suitable containing vessels in which an acid solution is circulated, using an insoluble anode material; or, further, the process may combine the use of soluble and insoluble anodes. The crude iron or iron ore being in each case connected to the positive pole of a dynamo, the iron goes into solution, and is deposited on cylinders or plates which may be either rotated or stationary, depending upon the class of finished product required.

In this way sheets of large dimensions can be made; by employing a mandrel, say 8 feet in diameter, a sheet 24 feet by 5 or 7 feet can be produced. When it is desired to produce tubes, iron mandrels somewhat smaller than the internal diameter of the finished tube are coated with lead by electro-deposition, or by having lead drawn over them. Thus prepared, the mandrels are rotated in a suitable apparatus. When the desired thickness of iron has been deposited the mandrel is heated to a temperature sufficient to melt out the lead, and thus admit of its easy withdrawal.

The electrolyte employed consists of a 20 per cent solution of sulpho-cresylic acid saturated with iron. The solution is kept charged with iron oxide, which is kept in suspension in the electrolyte by means of stirrers, by moving one or both of the electrodes, or by circulating by means of a bucket pump. The specific gravity of the electrolyte having the iron oxide in suspension is about 1.32.

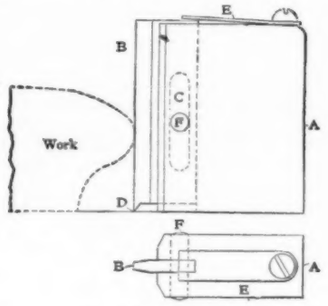
Excellent results have also been obtained by depositing the iron in a closed cell with a vacuum of a few inches, and also with a chloride solution and porous cells, bleaching powder being produced as a by-product; or the chlorine utilized to form fresh iron chloride.

The following are two typical analyses of electrolytic iron produced under the conditions described in this paper:

	I. Per cent.	II. Per cent.
Carbon (by combustion)	0.060	under 0.05
Silicon	0.011	0.048
Sulphur	0.016	0.045
Phosphorus	0.041	0.04
Manganese	traces	traces
Arsenic	0.004	0.01

A peculiar feature of electro-deposited iron is that it creeps to an extraordinary degree with a rounded, smooth edge over any material; in fact, it is difficult to stop its spreading. Under certain conditions, when employing a rotating cathode, long tentacles form 6 inches or more in length, in the direction of rotation with approximately the same curvature as the mandrel.

Among other applications the process can be applied



A SCRIBING TOOL

to the production of bi-metallic tubing and plates; that is to say, to tubes or sheets coated on the one side with copper or other metals or alloys.

The process can also be applied to the direct production of large sheets or strips representing the cutting surface of a file, and cut up into portions of the desired shapes, and secured to suitable backing, to form separate files. The prints are produced by making a continuous impression or a number of impressions from a suitable die, revolving roller, or reciprocating tool in a lead alloy. The matrix thus prepared is mounted on a revolving drum, and steel deposited by the process which has already been described.

Electrolytic steel, with considerable variation in the percentage of carbon, can also be produced. The amount of silicon in the iron can also be considerably varied. An important feature of the electrolytic process will no doubt be the introduction of some new ferrous alloys, which cannot be made by fusion. Alloys of iron and nickel have already been produced electrolytically, a sample of which is exhibited. Electrolytic iron sheets can be obtained with a highly finished surface, can be readily welded, coated with tin and zinc by dipping in a molten bath of these metals, coated with zinc by the Sherardizing process, or electro-galvanized. The structure of electrolytic iron varies considerably, and in some cases it is found to be amorphous; while in other instances it possesses a structure somewhat similar to that of wrought iron.

There is not the same tendency to form a definite crystalline structure as in the case of electrolytic copper.

The properties of electrolytic iron appear to depend largely on the amount of hydrogen present, and therefore on the annealing, which reduces or eliminates the occluded hydrogen.

Samples tested have given a hysteresis loss of under 0.3 watt per pound. The iron when charged with hydrogen is magnetic; and when magnetized, becomes a very powerful magnet as compared with ordinary steel.

Electrolytic iron always contains hydrogen in varying quantities, according to the conditions under which it is deposited, and the more hydrogen it contains the greater is its hardness.

The hardest varieties will scratch glass. Longheber has found electrolytic iron to contain 0.2 to 0.001 per cent of hydrogen. Although these figures appear small when expressed as weight percentage, they represent volumes of hydrogen to iron of between 12 and 110. When high-current densities were employed, deposits were obtained containing 110 times their own volume of the gas. Other investigators have obtained even larger percentages of hydrogen.

Electrolytic iron has a tendency, when deposited on a flat surface, to curve outward—that is, it becomes concave relative to the anode surface when deposited on the cathode. There are two distinct varieties of electrolytic iron, with varying percentages of hydrogen; the softer kind of iron is silver-gray in color, while the other variety is very hard and brittle, breaking as readily as glass, and containing a higher percentage of hydrogen. The hardness varies between these two extremes. A surface can be obtained on the latter of a silvery whiteness, and with a mirror finish without polishing, as will be observed by the specimens exhibited. Either quality can be produced at will by increasing or decreasing the electro-motive force at the terminals of the cell.

Iron highly charged with hydrogen is very inert, and not readily attacked by acids. The softer quality is also comparatively inert. Equal surfaces of wrought iron and electrolytic iron were immersed in pure hydrochloric acid, 2 deg. Twaddell, for eighteen hours. The electrolytic iron lost 2.48 per cent of its weight, and the wrought iron 13.13 per cent. The temperature required for annealing electrolytic iron is slightly in excess of that required for ordinary rolled sheets. Electrolytic iron, when heated in a closed annealing-box, gives off large quantities of hydrogen; and if a pipe is fitted to the annealing-box the hydrogen flame can be kept burning during the whole process of annealing, and for a considerable time after the heat has been removed from the annealing-box. This phenomenon has been turned to account for removing scales from ordinary rolled sheets by placing some sheets of electrolytic iron in an ordinary annealing-box with plates to be scaled. Electrolytic iron gives up considerable quantities of its hydrogen under 100 deg. C. without losing its brittleness, and also when boiled in water or oil.

When iron is deposited under magnetic conditions—that is, if a powerful magnet is placed behind the cathode—lines of magnetic force are obtained similar to those rendered visible with iron filings.

Plant for producing 5,000 tons per annum of electrolytic iron, in the form of tubes, sheets, and wire, and including 1,000 tons of iron under treatment, is estimated to cost $526,000, and the cost per ton of producing electrolytic iron tubes, sheets, and wire is estimated at $25.60.

* From a paper read before the Iron and Steel Institute.

A SCRIBING TOOL.

By M. A. HART.

THE sketch shows a tool for tracing the outline or edge of work that rises above a level surface and cannot be traced with a scriber in the ordinary way. Much drop-forging work calls for a tool of this kind when tracing the outline of the piece on the face of the die.

A, the scriber block, is made from three thicknesses of machine steel riveted together. *B*, the scriber, is made of tool steel hardened; it has a slot *C* and marking point *D*. *E* is a flat steel spring secured to *A* with a screw. *F* is a hardened pin through *A* and slot *C* preventing *B* from falling out. The object of spring *E* is to keep scriber *B* down on the surface to be marked.—American Machinist.

To detect the presence of formaldehyde, add to the liquid, if non-albuminous, a small quantity of albumen (a few tenths of one per cent), add a few drops of a 5 per cent solution of ferric chloride, and pour the liquid carefully upon the surface of sulphuric acid. A blue-violet ring is formed if much formaldehyde is present, while a very small quantity of formaldehyde produces a reddish-violet ring.

SELENIUM CELLS.*

THEIR MANY USES IN MODERN PHYSICS.

BY R. A. L. SNYDER.

THE element selenium was discovered by Berzelius in 1817. It can be obtained in various forms and applied to many uses, although its peculiar properties have been generally understood for only about thirty-five years. In 1873 while experimenting with selenium as an ohmic resistance, Willoughby Smith discovered that the resistance of this metal was reduced by exposure to light. In using sticks of selenium as a resistance in an experimental telegraph circuit, he had trouble with the current varying; on investigating he found that when the cover to a box in which he had placed the selenium was closed, the current was less than with the box open. Further investigation showed that the electrical resistance of selenium varied with the amount of light falling upon it.

Siemens, in 1875, carried out some valuable investigations of the properties of selenium, and his experiments revealed much of the various forms that selenium assumes under different conditions. After being melted and quickly cooled, selenium assumes a translucent, vitreous formation, and upon being held to the light will have a dark-red color. While in this condition it is a dielectric and can be electrified by friction, like glass. If, however, the molten selenium is cooled slowly it will assume a gray crystalline formation, become opaque to light, and will then conduct electricity. According to the electromagnetic theory of light, it would not conduct electricity did it remain translucent, as it is a well-known fact that all conducting metals are opaque to light.

Alexander Graham Bell took advantage of this property of selenium to invent a wireless telephone. This instrument, known as the photophone, transmitted speech over a beam of light. From 1880 to 1881 Prof. Bell, with Sumner Tainter, took out six or more patents on the photophone and selenium cells. These patents cover practically all the now known properties of selenium. Improvements in cells since that time have dealt principally with their practical application to various purposes rather than to any scientific investigation and improvement in their properties.

The photophone consists of a transmitter for varying the intensity of a beam of light by means of sound waves impinging upon it, and a receiver for converting the light waves at a distant point back into sound waves. The transmitter consists of a glass disk, silvered to reflect a pencil of light focused on it from the sun or an arc lamp. This glass disk is used as a diaphragm, similar to that of an ordinary telephone transmitter, except that the rear side of it is made free to reflect the beam of light. Prof. Bell successfully used for this purpose glass disks varying from 2 inches in diameter, and the thickness of ordinary paper, to 30 inches in diameter, and of proportionate thickness. The smaller disks gave the better results. The receiver consisted of a parabolic reflector with a selenium cell placed at its focus. In series with the cell was placed a battery and a telephone receiver.

This instrument talks quite distinctly and has been

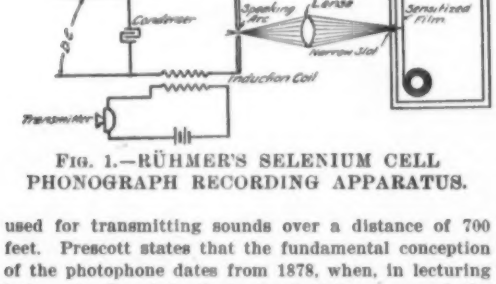


FIG. 1.—RÜHMER'S SELENIUM CELL PHONOGRAPH RECORDING APPARATUS.

used for transmitting sounds over a distance of 700 feet. Prescott states that the fundamental conception of the photophone dates from 1878, when, in lecturing before the Royal Institute, Prof. Bell announced the possibility of hearing a shadow fall upon a piece of selenium included in a telephone circuit. The photophone, however, outgrew the particular electrical combination that suggested it; for not the least of the remarkable points in this research is the discovery that audible vibrations are set up in thin disks of almost every kind of material by merely throwing upon them an intermittent light. If a glass bulb filled with fine charred cork dust and connected with a flexible tube be placed in the focus of the parabolic reflector of a photophone, the light waves will be converted into sound waves the same as with the selenium-cell battery and telephone receiver. The action of light on the burnt cork dust, however, is not the same as on the selenium. The sound from the burnt cork dust appears to come from sudden expansion of air in the bulb caused by the heat absorbed from the light striking the burnt cork. It requires very little energy to throw air into vibration, which is obvious

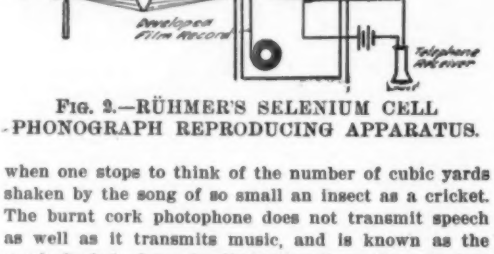


FIG. 2.—RÜHMER'S SELENIUM CELL PHONOGRAPH REPRODUCING APPARATUS.

when one stops to think of the number of cubic yards shaken by the song of so small an insect as a cricket. The burnt cork photophone does not transmit speech as well as it transmits music, and is known as the musical photophone in distinction from the selenium or articulating photophone.

It may be thought that the heat rays accompanying a light beam have a great effect in changing the resistance of the selenium cell, but this is not the case. If a filter of alum water be interposed between the source of light and the transmitter it will absorb the heat rays and allow the light to pass, but it does not reduce the effect on the selenium cell. In fact the light rays toward the ultra-violet end of the spectrum seem to have the most powerful effect.

After the speaking arc was discovered, it was not long before different inventors were trying its effect upon the selenium cell. Their efforts were successful and Herr Rühmer, the German scientist, was able to transmit speech by means of light to a distance of 15 miles. He placed the speaking arc in the focus of a parabolic reflector and collected the rays in a distant receiver similar to Prof. Bell's photophone.

Herr Rühmer also photographed the sound waves from a speaking arc upon a cellulofd film, and reproduced the sounds by passing the film between a source of light and a selenium cell in series with a battery and telephone receiver. Figs. 1 and 2 show the method.

The use of selenium as a measure of light intensity has always been a very attractive experiment. Selenium changes its electrical resistance in proportion to the amount of light falling upon it. If the selenium is in the form of a cell with a current flowing through it, the current will vary according to the resistance, or in proportion to the amount of light falling upon the cell; and any change in the current can easily be measured with our present instruments, thus making a direct-reading photometer. The one great objection to the use of selenium as a photometer, which has not been overcome, is that its resistance gradually changes. What is known as fatigue, or soaking, takes place; that is, the resistance of the cell will change rapidly when light first strikes it and keeps slowly changing for some time after. This soaking effect varies greatly with different cells. We have had some cells that acted very slowly, while others seemed to go instantly to a fixed value and stay there as long as the light remained constant. The return of selenium to its dark resistance is very much slower than its change to light resistance.

A photometer has been made with a cell in a bridge circuit with another compensating cell; this appears to give very good results. This apparatus has been on test for four or five months and while the measurements of it are rough, yet the cells apparently have not changed.

Mr. Fitzhugh Townsend has experimented quite extensively with selenium cells and he claims that the same curve for time and light can be secured day after day when readings are taken under certain conditions.

Numerous patents have been taken out for picture transmitting apparatus, based on the use of the selenium cell. It is probably only a question of time before a practical machine will be placed on the market. Just how valuable it will become remains to be seen. It may be a means of extending the business man's capacity for doing more work with less effort. It certainly will be valuable to newspapers.

Most of the machines so far invented consist of a receiving apparatus for varying the resistance of a selenium cell by throwing the light from the focus of a picture by successive steps from different parts of the picture upon the cell. The light from the picture is generally passed through a hole in a screen, which hole travels rapidly backward and forward over the picture, covering every portion of it in regular order. The picture may be produced by an object reflected through a lens or by a strong light reflected through a specially prepared transparent photograph. The receiving end is usually the hard part to design. A sensitized film of some kind is generally used to receive the picture. One of the most common forms, which works comparatively slowly, is to allow a point to travel over a piece of paper soaked with a chemical that bleaches out when a current passes from a pointed electrode dragged over its surface; the successive dots made by the current pulsations form a picture. One patent just issued uses a mechanical punch, worked by an electromagnet, for making the dots. The current along the line is reinforced by a relay. The sensitive arc flame and the oscillograph have also been tried. The oscillograph promises to give better results as a receiver than any of the others. All the machines of which descriptions have been published print the receiving picture, but none of them can transmit the image of an object from one end to be seen instantly at the other.

All picture transmitting apparatus depend upon parts at each end moving in synchronism, so that at the instant when the selenium cell is lighted up from a certain point in the picture and sends out a current it will work the receiving end and print a light spot corresponding to the transmitting end and in exactly the same position at the same instant.

Selenium cells are generally made by turning two spiral grooves on a short cylinder of pipe clay, porcelain, or lava, and winding two fine parallel wires in the grooves. The following is from an excellent paper by Prof. Townsend on the selenium cell:

"While in a crystalline form, the resistance of selenium is very high and not of much use. It is, however, sensitive to light. By heating for a number of hours either the vitreous form or the crystalline form just described the conductivity of the metal becomes greatly increased, and, if the temperature is reduced very slowly to atmospheric temperature, a high degree of sensitiveness to light is attained. It is in this conducting crystalline form that selenium is employed for signaling purposes. The vitreous form of the element melts at 210 deg. C. (410 deg. F.), but the crystalline forms have a considerably higher melting point.

"Selenium, even when in metallic crystalline form, has an extremely high specific resistance, and it is necessary, therefore, to construct a rheostat made of it in such a way as to offer a great many paths for the current between one terminal and the other. One of the most usual methods is to cut two parallel threads in a refractory tube made of glass or lava, or some such material. A pair of parallel wires are then put on the tube so that they run spirally side by side along the threads. These two wires form the

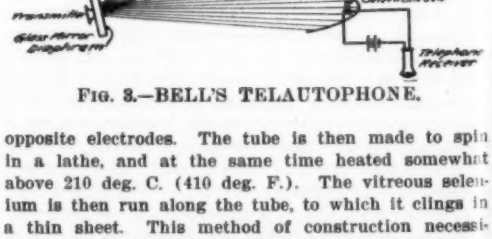


FIG. 3.—BELL'S TELAUTOPHONE.

opposite electrodes. The tube is then made to spin in a lathe, and at the same time heated somewhat above 210 deg. C. (410 deg. F.). The vitreous selenium is then run along the tube, to which it clings in a thin sheet. This method of construction necessitates the use of a parabolic mirror, because otherwise the light rays would only fall on one-half of the sensitive material. In order to obviate this, resistances can be constructed so as to be plane instead of circular. Alternate plates are connected together and to one of the binding posts.

"Another way of accomplishing the same result is to wind two parallel wires close together along a broad piece of refractory material, such as slate.

"In order to cut down the ohmic resistance, it is necessary to bring the adjacent wires or steps as near

* A paper presented at the Pittsburg Section of the American Institute of Electrical Engineers.

together as possible. This distance should be in any case considerably less than a millimeter. The selenium must be put on so as to form an extremely thin coating, because this light appears to act only on the surface of the metal, it being opaque; therefore, if any appreciable thickness is allowed, a great deal of current will be conducted from one electrode to the other through a part of the material which is not affected by the light, and it is desirable to cause the current to flow along the surface where the resistance is altered by the effect of the light rays.

"Since the two electrodes are composed of a series of wires or plates extremely close together, the effect of any moisture deposited on the surface will be very noticeable, and the surface must be kept dry if the resistance is not to be affected by atmospheric conditions. In the latest developments by Prof. Rühmer, of Berlin, the selenium resistance is inclosed in an exhausted glass bulb, this having been found to give the best results.

"Brass, copper, or silver may be used in the construction of a selenium resistance. One of the difficulties in the construction is to make the molten substance stick fast to the electrodes. The selenium appears to combine to some extent with the surface of the metal on which it is deposited when in a molten state, forming an extremely thin layer of selenide; this, however, is brittle when cold and extremely liable to chip off. If the copper or brass is slightly tinned, the adhesion of selenium is facilitated.

"After the selenium has been successfully laid over the electrodes in the form of a thin sheet, the resistance thus formed should be baked in an oven at a temperature of approximately 190 deg. C. (374 deg. F.) for a period of three hours, after which it should be slowly cooled; this process occupying possibly another three hours.

"The prolonged baking and slow cooling have the effect of reducing the ohmic resistance, and increasing the sensitiveness. Experiments carried out have been to determine the effect of slight impurities in the selenium used, and it was found that one or two per cent of copper selenide or nickel selenide could be present without affecting to a marked extent the sensitiveness of the resulting resistance."

EXPERIMENTS ON WATER RESISTANCE.*

A DIGEST OF SOME LOW-VOLTAGE TESTS OF ALTERNATING CURRENT MACHINERY.

BY KARL WALLIN.

OBJECTIONS have been raised to the use of water resistances for the testing of alternating current machinery. It has been supposed that condenser effects might arise, and be of such a magnitude as to cause appreciable errors in the results. Among other things it has been pointed out that the determination of the fall of voltage in alternators and transformers by means of a load obtained by water resistances gives too favorable results and that it is indeed possible to have a rise in voltage with increased current under these conditions (see Kapp on Transformers, p. 141 and the following pages of the second German edition). Consequently it would not be possible with voltmeter and ammeter to test the performance of alternate-current machinery by this method. The following experiments, however, tend to show that the objection is of a purely theoretical and not of a practical nature.

The author has carried out tests in the Technical High School at Stockholm in order to investigate the problem, using low voltages. The electrodes consisted of two rectangular iron plates, kept at a small distance apart by a wooden framework, and separated by a U-shaped copper wire covered with gutta percha, which was placed between the edges of the plates. The containing vessel was filled with distilled or tap water, as desired. The exposed surface of each plate was 4,300 square centimeters, and the average distance of the plates apart was 0.6 centimeter. During the tests the voltage and current were determined by

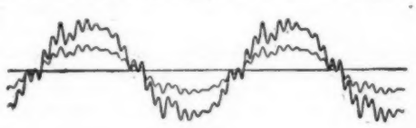


FIG. 1.

very accurate instruments, and oscillograms were taken by Duddell's methods. A few of the results are given below, as obtained with different kinds of water:

No.	e.	i.	s.	d.	
1	7.92	0.1	567,000	0.23	Fig. 1
2	113.00	2.0	404,000	4.65	Fig. 2
3	55.00	50.0	7,880	116.00	Fig. 3

where e = volts, i = amperes, s = calculated specific resistance in ohms per cubic centimeter, and d = current density in amperes per square meter. For larger currents a solution of soda was used. Currents were passed up to 1,000 amperes, but the oscillograms were exactly as in Fig. 3, and the voltage and current curves were exactly superimposed.

From this it appears that no phase displacement arises in consequence of the dielectric properties of water, although the distance of the plates apart was very small as compared with the areas exposed. Moreover, the watt components of the current were undoubtedly much smaller than is likely to be the case in practice, more especially in the case of distilled water. Seeing that no displacement could be noticed, it is fair to suppose that no capacity effect is likely to complicate results if water resistances are used for the purpose of alternate-current tests.

Supposing a soda solution to be used, it is possible for a phase displacement to arise under certain conditions. In order to investigate this, several experiments were carried out with soda solutions of different strengths, and both with fixed and adjustable electrodes. The fixed electrodes consisted of three parallel iron plates, at distances apart of 0.14 centimeter, the middle one serving as the one electrode, and exposing a surface of 220 square centimeters to the fluid. The movable electrodes consisted of plates 15 centimeters by 15 centimeters, and arrangements were made so that the distance between them could be reduced to 0.15 centimeter, if desired. The results

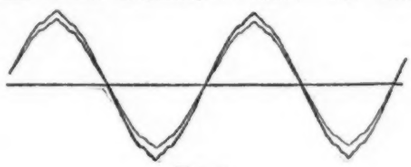


FIG. 2.

showed, as might have been expected, that the greatest phase displacement arises with a highly saturated solution and with the plates close to one another. Curiously enough, when using an absolutely saturated solution, containing 3 kilogrammes of anhydrous soda and 12 liters of water at the boiling point, no phase displacement or alteration of curve could be noticed. With this solution a test was made to notice the effect of heavy currents. For this purpose an iron rod, 0.5 centimeter in diameter, was used as one electrode; a length of 5 centimeters was immersed, giving a total surface of 7.8 square centimeters, and a current of 40 amperes was passed at 20 to 30 volts. The water boiled violently round the rod, and there was a strong humming noise. On lifting the rod slightly, flashes of light were caused, accompanied by rather violent explosions and an unsteady current. The volt and current curves were steadily superimposed, and jags and unevenness were only caused when the rod was moved. A comparison of the results with solutions of different strengths shows that with a 0.5 per cent solution there is no noticeable capacity effect; on the other hand, it is well marked when using a 5, 10, or 15 per cent solution, and passing 20 amperes at from 0.9 to 1.5 volts.

Although the result produced is very similar to that of a condenser, the current curve with a water resistance has no well-marked harmonics. Fig. 4 shows a voltage and a current curve for a condenser in parallel with an ohmic resistance. The condenser took 0.661 ampere, and the resistance 0.22 ampere. Although the phase displacement is small, it will be noticed that the harmonics in the current curve are more marked than in the voltage curve.

On the whole these experiments show that resistances consisting of iron plates immersed in soda solution may cause the power factor to be distinctly less than unity, but only in the case of very low voltages. This effect disappears almost entirely at higher voltages, and is practically negligible at 100 volts. For the purpose of testing transformers and alternators the power factor may safely be taken as being unity.

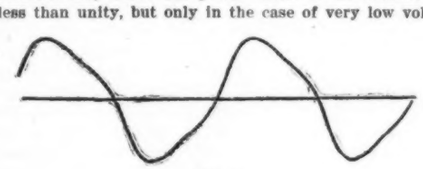


FIG. 3.

* Abstracted from the Elektrotechnische Zeitschrift.

The practical character of the recommendations made by the Public Service Commission, Second District, New York, is shown by the following excerpts from the 1907 report of that body: That a certain trestle on a suburban road should be reconstructed, and until this is done no train or car should run over this trestle in less than four minutes. That a certain high-speed interurban road equip all the curves on its railroad of two degrees or over with standard oak or yellow pine ties and rail braces. That all cars operated on certain street grades of a city railroad be equipped with sand boxes. That a certain interurban road put in operation a proper method of issuing train orders, including proper blanks for the use of train dispatchers and train crews.

MAKING CONCRETE TELEGRAPH POLES.

AN interesting process has lately been adopted by an English firm for manufacturing hollow, tapering concrete telegraph poles as well as pipes for conveying water, gas, oil, etc., under pressure. It has been customary to regard concrete as a material which has to be cast in a mold, but this machine uses the concrete as a plastic material, somewhat like clay, and the poles and pipes are not cast in a mold. In general, the process of manufacturing concrete poles, as described by Page's Weekly, is as follows:

A long core of sheet iron is mounted on two trestles running on rails so as to be capable of rotation and longitudinal movement. Upon this sheet-iron core longitudinal steel rods of small size are fixed. This core is drawn through the machine employed, which is stationary. Concrete made of clean screened grit and Portland cement is discharged into a hopper or

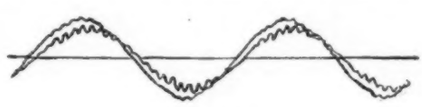


FIG. 4.

drum, in which rotating paddle wheels regularly discharge the concrete upon a bandage of coarse cloth webbing laid on a conveyor belt that takes one lap round the core. This continuous traveling conveyor belt is stretched so that it wraps the concrete round the core under great pressure. As the core issues beyond the conveyor belt, steel wire is fed spirally round it so as to press into the concrete wrapping, and small rollers then apply great pressure by working on the webbing, the slack of which, produced by the reduction in circumference and external diameter resulting from this pressure, is taken up by another contrivance. The core, therefore, as it issues from the machine is wrapped round spirally with a bandage of cloth containing the concrete. The machine pulls the trestles with the suspended core regularly forward, so that the core passes through it as the concrete is wrapped round it, and when the core has passed completely through the machine, it is lifted by an overhead traveling crane and placed on one side for the concrete to harden. In about twelve hours the interior sheet metal core is reduced in diameter by a screw attachment inside and withdrawn from the pole. After hardening for about six days, the bandage of webbing is removed and the pole is then complete. The thickness of the shell of the pole is from one to two inches, according to the height and the strength required, and the reinforcement is likewise varied according to circumstances. Poles are made by the machine above referred to up to 39 feet long, and pipes up to 20 feet long and 2 feet in diameter. Pipes are manufactured in the same way as poles, the smaller pipes withstanding pressures up to twelve atmospheres, and the larger pipes up to six atmospheres.

AN ANIMAL AS AN ENGINEERING STRUCTURE.*

SOME FACTORS OF SAFETY PROVIDED BY NATURE.

BY PROF. S. J. MELTZER.

THE living animal body is like a machine in action. Like a machine its structures are subject to a variety of stresses, and like a machine the work is accomplished by an expenditure of energy derived from a supply of fuel. I intend to discuss in this paper whether, as in the human-made machines, the structures and functions of the animal mechanism are provided with factors of safety. The term "factor of safety" is employed in engineering to designate the margin of safety required in the building of engines, bridges, houses, etc. For instance, in designing a boiler, if the tensile strength of the steel of which the plates and stay-bolts are made, is 60,000 pounds per square inch, the actual stress which is allowed for the work of the boiler should not be more than 10,000 pounds per square inch for the plate and not more than 6,000 pounds per square inch for the stay-bolts; that means the stress to which the plates or the bolts may be exposed in the boiler should only be one-sixth or one-tenth of the actual strength of the steel. The factors of safety are said to be here six for the plate and ten for the bolts. In some instances the required factors of safety may be as low as three, in other cases again they may be as high as twenty and even forty. The character of the stress to which the structures might be subjected is an important point in deciding upon the size of the margins of safety. Structures, for instance, which are to be employed for alternating loads require high factors of safety; the highest margin of safety is required when the structures are subjected to rhythmic shocks. In constructing a bridge or a machine it is then calculated that the structures should be capable of withstanding not only the stresses of reasonably expected maximum loads, but also the stresses of six or ten times the size of such loads. The factor of safety has its foundation in our ignorance of what might happen and in the reasonable desire to meet unexpected contingencies. Some writers are therefore inclined to designate the factors of safety as factors of ignorance.

It is obvious that the factors of safety are applicable not only to the structures, but also to the supply and expenditure of energy of the machine. The supply of fuel is calculated to have the engine in readiness not only for expected maximum work, but also to be capable of meeting unexpected contingencies. On the other hand, when there is no exceptional need for it, no engine is allowed to perform maximum work; this economy here is again a factor of safety.

Are the structures and the functions of the living animal body provided with such factors of safety? As far as I know, that question has never yet been clearly raised, and certainly was never made the subject of a direct investigation. There is, however, no lack of casual remarks bearing on that problem and these are manifestly unfavorable to an assumption of the existence or requirement of factors of safety in animal organisms. On the contrary, there are many to whom it is apparently self-evident that nature is economical and wastes neither material nor energy. Theories and practical suggestions are based on such a view as a premise which seems to their authors to require no special proof. Verworn, for instance, asserts that the assumption of special inhibitory nerves for skeletal muscles can be rejected *a priori*, because the presence of such nerves would be a waste of matter and energy and in contradiction with the prevailing principle of economy in the animal body. Another instance is the extreme position held by some recent writers with respect to the supply of energy to the animal machine. Factors of safety, maximum or optimum supply of fuel, do not come in for a consideration in the discussion of these writers. The argument is directed against the use of a dietary standard which represents the average mean supply of energy, the minimum supply of food being considered as the ideal standard of diet. As is known to all of you, Prof. Chittenden and his co-laborers have carried out nutrition experiments of long duration upon a number of men. The essential feature of these experiments was the use of a low proteid diet; in some instances the diet was also combined with a considerable reduction in the caloric values of the food. All the subjects of the experiments retained their usual health. Prof. Chittenden admits that the diet used in these experiments, especially with regard to the proteid intake, represents the minimum requirement of the human body; he, nevertheless, earnestly advocates its acceptance as a general standard of diet, assuming *a priori* that the minimum food with which a number of men can manage to live for some time without harm is the desirable standard of supply of energy for all animal machines. Whereas in the economy of the human-made mechanisms and, in fact, in the economies of all human organizations, decrease in supplies and increase in expenditure lead invariably to disaster, it would seem that in the physiological economy of the living mechanism such a procedure may even lead to a greater efficiency of the mechanism. Prof. Irving Fisher tells us recently that nine Yale students under the influence of prolonged mastication of a diet greatly reduced in proteid and in caloric values, gained very much in endurance in performing certain physical tests.

Is there, indeed, a difference between the economies of human-made organizations and those of the living organism? I have stated above that the factors of safety in mechanical constructions are after all only factors of ignorance. Possibly wise nature constructs her organisms on such an efficient principle which permits the accomplishment of the greatest amount of work on a minimum supply of material and energy. It would be a fascinating distinction between a dead mechanism and a living organism—if true.

The subject of this lecture will be an investigation of this question, an investigation whether the structures and functions of the animal organism are constructed with a special consideration for the greatest economy or for the greatest safety. Or to leave the purposefulness of the organization out of discussion, I may perhaps put it more correctly by saying that it will be essentially an investigation into the ratios of the supply of material in many organs of the body to the amount of work they are expected to perform. I believe that the investigation may lead to some instructive general conclusions of a theoretical and practical character. As already stated, the problem seems to me to be new and, as far as I know, no original investigations were carried out with the special purpose of solving it. There are, however, a great many well-established facts brought out in theoretical and practical work undertaken for other purposes, which are, nevertheless, capable of throwing a good deal of light upon our problem. Such facts have the advantage of being unbiased witnesses, since no preconceived theory was at the bottom of their discovery. My task will consist in reviewing these facts as far as they are available, or more correctly, as far as they are known to me, and bringing them impartially in proper relation to our problem.

I shall commence with the plain tissues of the body. In the multitude of studies on these tissues there are not many investigations which could be utilized for our purpose. However, a series of careful investigations, recently published by Triepel, have an intimate bearing on our problem. Triepel investigated the elasticity and resistance of several tissues, like muscle, tendon, elastic tissue, bone cartilage, etc. For us the following statements are of special interest. For muscle, tendon, and elastic tissue Triepel found that the maximum stretching which may occur in the animal body is not far below that degree which can cause tearing of these tissues. The resistance of bones and cartilages to a crushing stress is however far above any stress which might occur in normal life. With regard to muscle, tendon, and elastic tissue it appears, therefore, that the structures in themselves have practically no factors of safety above the maximum stress to which they might be subjected. Any unexpected tension above the maximum occurring in ordinary life might lead to a rupture of these tissues. Triepel, however, calls attention to the fact that the degree of stretching of these tissues is greatly limited by their connections with the structures surrounding them, especially by the skeletal parts. These limitations will for the most part prevent these tissues from reaching their breaking point. We may then say that muscle, tendon, and elastic tissues have no factors of safety in the structures themselves; but they are provided, nevertheless, with some such factors by their connections with other tissues. The bones and cartilages, on the other hand, which are but little influenced by other tissues, are provided with a very large margin of safety over the stresses to which they might be exposed normally. Triepel here makes a remark which has a direct bearing upon the problem with which we are dealing. He says that the large surplus of material in bone and cartilage shows that nature does not follow the law of obtaining a result by the smallest possible means.

It is worth noticing that the large margin provided here can not have the object of offering protection against unexpected contingencies coming from within the body, as these, according to Triepel, will never reach even the yield-point of these tissues. The protection is here provided against contingencies coming from without, against injuries of external origin. It is a protection not against an internal, a physiological calamity, but against an external, so to say pathological, contingency.

A sufficient number of readily available data for the study of our problem we find in researches upon complex tissues or organs. We shall begin with the bilateral mechanisms. Here are, in the first place, the kidneys. Every medical man knows now that one kidney can be removed with entire impunity, if the other kidney is normal. The amount and the composition of the urinary secretion remains practically unaltered and this even soon after the removal of the kidney. That can only mean that normally the kidney has an abundance of tissue which can do at a moment's notice at least twice the normal amount of work. From the experimental work of Tuffier, Bradford, and others we know that at least two-thirds of both kidneys may be removed without serious detriment to the animal's life and to the secretory function of the kidneys. At the same time we must remember that the normal secretion represents by no means the minimum amount of work of the kidney. We know that the average quantity of the urine as well as the normal quantities of its various constituents may be greatly reduced without any visible detriment. In fact there may be anuria for many days without any serious consequences, if the anuria be not due to a disease of the kidney, but to such causes as hysteria, calculus, reflex, or compression. The margin of safety in the tissue of this eliminating organ amounts at least to twice its normal need.

This would seem to be an unreasonable luxury, a waste. But what a blessing! For a score of years or more, in many of us the kidney is gradually losing some of its valuable material from one cause or another without any symptom, without a reminder sufficient to spoil our pleasure of life or to hamper our activities. Not until that luxurious surplus is approaching its exhaustion, do we get a warning. But then our work is mostly done and our time limit nearly reached.

Next we shall consider the lungs, an organ of supply and elimination of first order. We all know that life may continue though a great part of the lungs be destroyed, if only the disease which caused the destruction come to a standstill. We know that in some cases of pneumonia one lung can be entirely consolidated without seriously impairing the process of ventilation. Furthermore, a patient whose thorax was freely opened to evacuate a one-sided pleural abscess has after the opening less dyspnœa than before. In empyema as in pneumonia, it is essentially the infection and intoxication with their reactions which cause the apparent disturbance in the respiratory mechanism and not so much the mechanical interference with the ventilation of the corresponding lung. Since the classical experiments of Regnault and Reiset many investigators have stated that compression of one lung or a unilateral pneumothorax exerts very little influence upon the respiratory exchange of gases. Hellin reported recently a series of experiments on rabbits in which the right lung was completely removed. The right lung of the rabbit has four lobes and is much larger in volume than the left; that means that more than one-half of the lung tissue was removed. Most of the animals survived the operation and some lived a year longer. Except for a temporary moderate dyspnœa lasting only an hour or two the animals were in a normal condition, and the respiratory quotient continued to be after the removal of the lung exactly as it was just before the operation. We see then that the normal process of respiration can be carried out with at least one-half of the lung tissue and probably with a good deal less. We have here with regard to the quantity of tissue a factor of safety equal at least to two, which does not appear to be an excessive margin considering the importance of the function which that tissue has to carry out.

Among the bilateral organs there are two whose functions are carried on exclusively by internal secretion. I mean the thyroid and the adrenal glands. We do not notice their activity while they are present, but we recognize their importance by the serious effects which follow their removal. The complete removal of both thyroid glands is followed either by

* Harvey Society lecture, delivered at the New York Academy of Medicine.

acute symptoms of a tetanic type or by chronic states which are known under the names of myxœdema and cretinism. It is, however, a well-established fact that the removal of four-fifths or even five-sixths of both thyroids is not followed by perceptible consequences, which means that one-fifth or one-sixth of the entire gland is amply sufficient to provide the body with the indispensable substance contained in the secretion of the gland. It was just on that account that at first the experimental results showing the importance of this gland were disputed by some observers: small accessory glands were hidden in some cases which made the apparently complete removal of both thyroids ineffective. The thyroid gland possesses, accordingly, four or five times more tissue than necessary for the complete maintenance of health and life of the animal.

In recent years some of the symptoms following the removal of the thyroid gland, especially the acute manifestations, are ascribed to the simultaneous removal of the epithelial bodies known as parathyroids. They are four in number. I do not know of a statement dealing directly with the question how much of the parathyroids has to be removed in order to bring out the pathological effects. However, in the dog the parathyroids are imbedded in the thyroids, two in each lobe, and some of the actual symptoms following the removal of the thyroids in dogs are ascribed, as stated above, to the simultaneous removal of the parathyroids. By the removal of four-fifths of the thyroids surely two and probably three of the parathyroids are also removed. But since the removal of four-fifths of the dog's thyroids is not attended with any evil consequences, we may also conclude that a good deal of the substance of the parathyroids can be dispensed with without any ill effects.

For the suprarenal glands it is now well established that their removal is absolutely fatal to the animal. Death follows within nine to thirty-six hours after the extirpation of the glands, under conditions of low blood pressure, extreme muscular weakness and exhaustion. But the removal has to be complete; if one-tenth of the glands or even less is left in the body, the animal shows no pathological symptoms. Here again, as in the thyroid, this fact caused the divergence of opinion which sprang up soon after Brown-Sequard made the discovery of the importance of this ductless organ. In many of the experiments bits of the tissue of that organ were left behind; besides, many an animal hides somewhere accessory organs of the same type. For the adrenals then it is evident that the body possesses indispensable tissue at least ten times as much as is necessary for the maintenance of normal life.

The brain is built on a bilateral plan. In former years, when following the lead of Flourens and as a reaction to the teachings of Goll, the brain was considered as a uniform organ, attending only to one function, some facts seemed to demonstrate indeed that there is a great excess of tissue in that organ, since the older experiments of Flourens and newer experiments of Goltz indicated that large parts of the brain could be removed without serious injury to life. To-day we know that the brain presents a collection of many organs, of many centers, the injury of each of which is followed by sensory or motor disturbances in definite areas of the body. As a whole, the bilateralness of the hemispheres does not mean the same as bilateralness in other organs, namely, a duplication of tissue for one and the same function. One hemisphere attends to the needs of one side; for instance, the motor areas of the right arm or right leg are located in the cortex of the left hemisphere, and those of the left arm and left leg are located in the right hemisphere. The same is true of the subcortical centers and apparently also of the medulla oblongata.

To this rule there is, however, an exception for the motor organs having in charge such muscles or group of muscles which normally contract on both sides simultaneously. The motor area of one side can take charge of the muscles of both sides. Such is the case with the motor areas of the respiratory muscles, the muscles of the larynx, of deglutition, etc. An injury to the motor areas of these muscles in one hemisphere only does not cause paralysis of these muscles. An instance well known to practitioners is the one-sided injury to the motor area of the orbicularis palpebrarum. The muscle, as a rule, is not paralyzed by such an injury, at least not when the muscles on both sides contract simultaneously. As is well known, the absence or presence of paralysis of that muscle in cases of facial paralysis serves as a means to diagnose whether the paralysis is of central or peripheral origin.

An example of an uneconomical principle, to use the expression of Verworn, we find in the bilateral innervation of certain viscera by the pneumogastric nerves. For instance, the normal rhythm of respiration is completely changed when both vagi are cut, whereas when only one vagus is cut, the respiration remains normal. Apparently one vagus nerve is amply sufficient to carry on the regulation of respiration. A similar condition obtains with regard to the heart beats. For certain animals, the dog for instance, the vagi carry on an inhibitory tonus. When both vagi are cut, the heart beats are considerably increased in frequency; when only one vagus is cut, the rate does not change. Here again a single vagus nerve is sufficient to carry on that inhibitory tonus. Still more striking is the following fact: After cutting both vagi, the animal dies within a day or two from aspiration pneumonia, whereas when only one vagus is cut, the animal not only survives the operation, but is for all purposes apparently perfectly normal. One vagus nerve then is amply sufficient to carry on all these functions; but the body is provided with two nerves. According to Verworn this should be an example of a violation of the principle of economy in the animal body and its existence should be denied *a priori*.

Further examples of the ample provision of the structures of the body with factors of safety we meet also in the organs of the body which are not built on the bilateral plan, the unsymmetrical organs. We shall mention here first the pancreas with respect to its internal secretion. It is now common knowledge that the complete removal of the pancreas leads to glycæmia and glycosuria. But here we note the fact that if a small part of the gland, say not more than one-tenth, is left in the body, no ill effects follow such an extirpation. One-tenth of that gland is capable of completely protecting the animal against glycosuria; but the body is, nevertheless, provided with ten times as much.

Another striking example is the liver. This organ has many important functions. It converts the sugar into glycogen; it converts the poisonous ammonia compounds into the comparatively harmless urea. It forms bile which carries out poisons from the body, removes waste products, assists in some way or another in the absorption of fats, aids in the digestion of proteids and what not more. But Ponfick found that the removal of one-half of that organ practically does not interfere with the life of the animal, and the successful removal of even three-fourths of the organ does not produce symptoms indicating that any of its functions are seriously interfered with. That organ then is provided with an abundance of active tissue considerably in excess of its normal requirements.

Similar striking examples of factors of safety we meet with in the luxurious construction of the gastro-intestinal canal. The entire stomach or the greatest part of it has been removed in animals and man without interfering with digestion and nutrition. Of the small intestines large parts have been resected without serious consequences. In human beings the largest part removed measured, I believe, over three meters, and Erlanger and Hewlett have studied the metabolism of dogs seven or eight months after the removal of 70 or 80 per cent of the movable part of the small intestines. Three-fourths, then, of the small intestines are almost a luxury to the body. We need not, perhaps, speak of the fact that surgeons have removed large parts of the colon without ill effects. From the present attitude of bacteriologists and physiological chemists toward the activities of the large intestines one is led to believe that the body might do best without any part of that organ. Be this as it may, it is quite sure that the digestive canal is provided with a good deal more structure than is required for the maintenance of its function.

Here we shall discuss briefly also the luxurious provision of the alimentary canal with digestive ferments. There are two proteolytic ferments: pepsin and trypsin, to which we may add also erepsin, a ferment found by O. Cohnheim in the mucous membrane of the small intestines, and which is said to be capable of splitting albumose into amino acids. There are two amylolytic ferments: the ptyalin of the salivary glands, and the amylopsin of the pancreas. As to lipolytic ferments, the steapsin of the pancreas is not the only one of that kind which reaches the contents of the digestive canal. Thus several investigators have recently confirmed the statement of Volhard that the fundus of the stomach secretes a lipase which is capable of splitting emulsified fat. Lipase is contained also in the liver and in the bile.

Now there are a number of experiments and clinical facts which go to show that digestion can continue in normal fashion even if one-half or at least a good part of these ferments are eliminated from the digestive tract. Older and recent experiments have established the fact that the removal of the salivary glands has no effect upon the digestion. We know, on the other hand, that after removal of the pancreas or in cases of isolated destructive diseases of this organ the digestion of carbohydrates is not disturbed. Normally, therefore, there is a superabundance of amylase in the digestive canal. As to the proteolytic ferments, we have already mentioned that the complete removal of the stomach does not disturb digestion. Furthermore, in cases of achylia gastrica, in which the stomach secretes neither hydrochloric acid nor pepsin, the proteid digestion is apparently normal. On the other hand, we know that the elimination of the pancreas does not affect palpably the proteid digestion. With regard to lipase, clinical pathology was teaching that in cases of disease of the pancreas the stool contained fat which would seem to indicate that in the absence of the pancreatic lipase no other lipolytic ferment was present in sufficient quantity to split completely the ingested fat. However in a very recent study of Umber and Brugsch it was shown that the fat-splitting function is carried on even in the absence of the pancreas in a normal way.

We are then surely justified in claiming that the various digestive ferments exist in the alimentary canal in quantities far above the necessities for the digestion of a normal amount of food.

All the numerous organs and complex tissues which we have just passed in review are built on a plan of great luxury. Some organs possess at least twice as much tissue as even a maximum of normal activity would require. In other organs, especially in those with an internal secretion, the margin of safety amounts sometimes to ten or fifteen times the amount of the actual need. An extreme degree of superabundance and actual wastefulness we meet with in the organs and functions having charge of the continuation of the species. Let us illustrate it by the following few data: The ovum exists for the purpose of reproduction. Assuming that the sexual function of a woman lasts forty years and assuming, further, that every ten months of these years would be taken up by a pregnancy, then only fifty ova would be required of the ovary. But assuming even that a regular menstruation is an essential and indispensable part of the sexual function, then five hundred ova would be the maximum that the function of reproduction could use. Nevertheless, we find that the ovary of the newborn female child possesses between 100,000 and 400,000 eggs, and at the time of puberty there are still about 30,000 ova ready to enter upon their possible mission. That is, the ovary contains at puberty sixty times more ova than the body could possibly ever employ. But there is an incomparably greater waste in the provision of the male germ. According to Rohde each ejaculation contains 226 millions of spermatozoa. Now we know that of all these legions only one single spermatozoon is required and only one can be used. What a marvelous waste of living cells for the sake of assuring the perpetuation of the species! But there are some extenuating circumstances. With a velocity of only 0.06 of a millimeter per second, with the dangers of crossing the sea of fatal acid vaginal secretions and with a resistance to the onward progress offered by the cilia of uterine epithelium swaying in the opposite direction, not too many of the storming millions stay in the race and have a chance to reach the goal. At any rate, it is not by economy, but by immense waste of cell life that the chance for continuation of the species is assured.

In striking contrast to the extreme luxuriousness of provision of tissue in the organs previously described stands out the comparative scantiness of cell tissue in some organs—if we may call them so—of the central nervous system. The centers of the medulla oblongata, for instance, present such minute bodies that hardly a part of any center could be injured without endangering the entire function. Any injury to the respiratory center suspends immediately and permanently the function of respiration. The possible existence of some respiratory centers in the spinal cord does not alter the practical result. The same applies to the center of deglutition. The blood pressure, as we shall see later, is provided with quite a large number of safety factors. However, the immediate effect of an injury to the vasomotor center is a dangerous drop in blood pressure, the restitutions and compensations over which the organism commands are not forthcoming until after a long interval. We may point out, however, that the central nervous system is provided externally with factors of safety against two of its main enemies: it is protected by a bony encasement against any physical injury and especially is the medulla oblongata well hidden away, and it is protected by an abundance of blood vessels against dangers of anæmia.

(To be concluded.)

Oak Polish (American) is made as follows: Mix 1,500 parts of finely precipitated chalk, 500 parts of siccative, 1,000 parts of boiled linseed oil, with benzine, color with umber, some lampblack, and burnt sienna. Smooth the oak to be polished carefully and with a brush coat it with this fairly thick fluid mixture. After the mixture applied is dry rub it down, smooth it with glass powder and coat it again with the same mixture. After this filling and when it has been rubbed down with stemwood shavings or fine sea grass comes one or two applications of shellac coating, consisting of white shellac and wood alcohol for oak, brown shellac for cherry and walnut. This coating is rubbed down with sandpaper and coated with varnish, either polishing varnish, which is polished with the ball of the hand and a soft brush, or interior varnish, which is rubbed down with oil and pumice stone. These polishes are as hard as glass, transparent, of fine brilliancy, and wear-resistant.

CASTING PIPES IN PERMANENT MOLDS.—II.*

A NEW PROCESS OF MANUFACTURE.

BY EDGAR A. CUSTER.

Concluded from Supplement No. 1718, page 362.

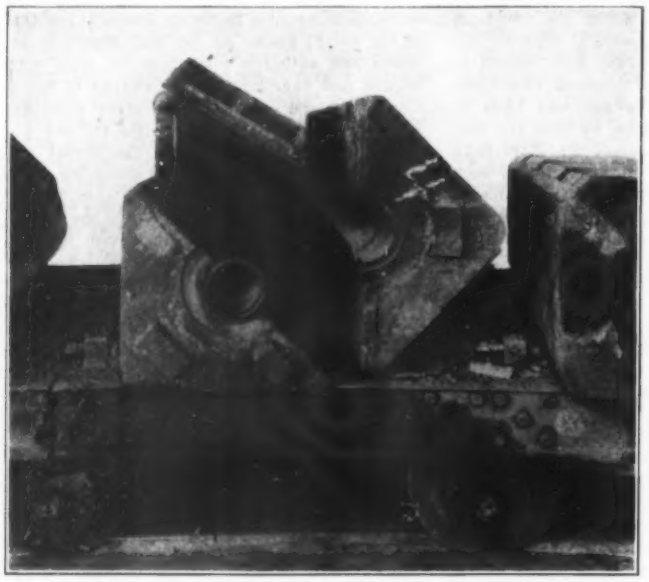
WITH the data obtained, the work of designing a machine that would operate continuously was begun. The experiments had shown that when pipes were cast in a mold every eight minutes, the temperature of the mold never rose above 450 deg. F., even if the operations were continued for hours. If pipes were poured every two minutes, the temperature of the mold rose rapidly, and at 900 deg. F. it began to warp. In order to follow the best conditions and avoid the worst, the following apparatus was designed:

The machine consists of an angular table or ring approximately forty feet in diameter, carrying thirty molds, arranged at equal intervals thereon. The table is constructed of two concentric rings of channel beams, connected with thirty cross-pieces or trucks, each of which has two wheels having roller bearing axles. These wheels are arranged to run on concentric circular tracks set in concrete foundations. The tracks are arranged as if on the surface of a cone, and by this means is created a tendency of the table to resist any movement other than rotating about its center. Either outer or inner track may be the higher, as the effect is the same in either case.

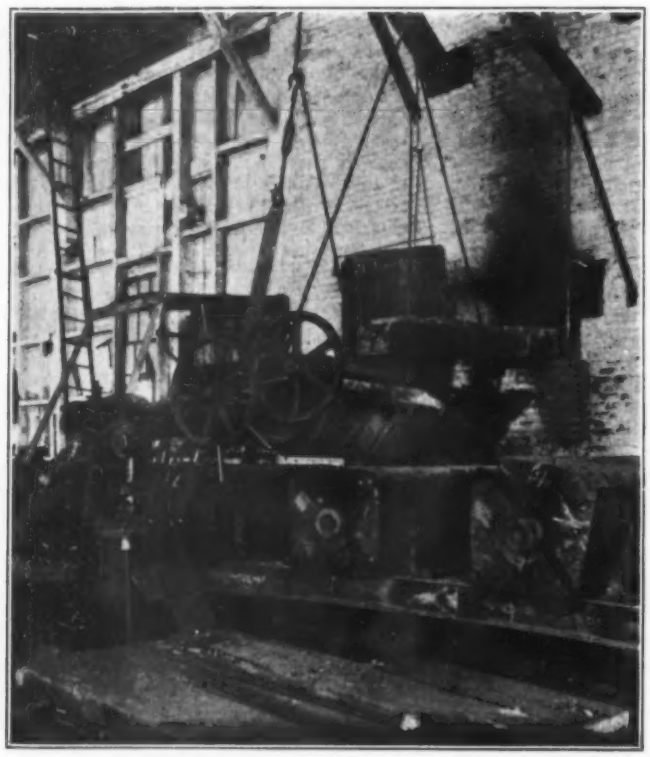
Each truck or cross-bar of the table carries a steel pin working loosely in a vertical hole, and of such length as to allow about two inches of pin to project below the bottom line of the truck, but admitting of being pushed up until flush with the bottom of the truck. Under the table or ring, at two diametrically opposite points, are arranged two hydraulic cylinders which slide in ways similar to a planing table, the pistons within the cylinders being held stationary and the cylinder moved back and forth by the operation of a four-way valve controlling the admission of water, alternately to each end of the cylinders. The stroke of the cylinders is of such length as to be slightly more than the spacing of molds carried by the table, and projecting from the top of the cylinder is an inclined plane surface designed to lift the pins in the trucks, when the cylinders move in a direction opposite to the required motion of the table, and to allow a pin on each side to fall, after the inclined surface has passed. This occurs at or near the end of the backward stroke of the cylinders, and when the controlling valve is so moved as to cause the cylinders to move forward, the pins which have been lifted and allowed to fall are brought in contact with the projections on the cylinders, and hence the table is carried forward by the motion of the cylinders, a distance equal to the spacing of the molds, and the cylinders are ready for another return or back stroke to engage the next pins, thus intermittently moving the table ahead one space at each cycle of the cylinders.

The center of the table is left open for the location of hydraulic pumps, operating valve reservoirs, etc., required in imparting motion to the table. This table makes one complete revolution every seven and one-half minutes and consequently produces thirty pipes in that time, or two hundred and forty pipes an hour.

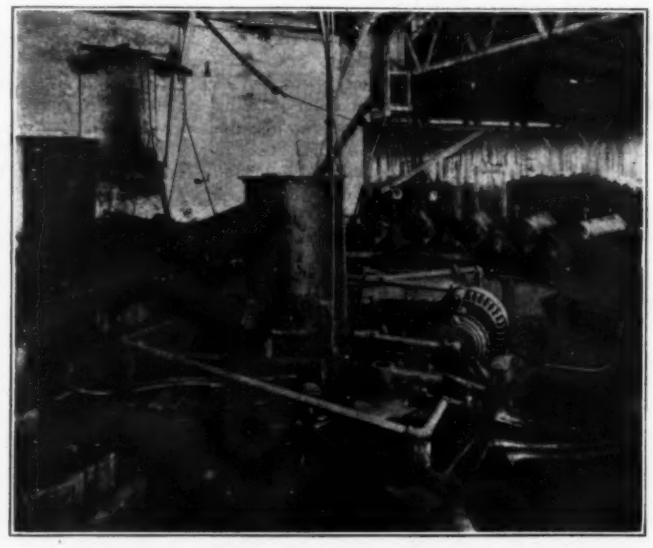
At certain points about the table are arranged closing and opening devices, which are designed to close



MOLD ENTERING CLOSING DEVICE. CORE IN PLACE.



END VIEW OF THE ORIGINAL POURING DEVICE.



MOTORS, PUMPS, VALVES, PIPING, AND RESERVOIR.

OPEN MOLD, SHOWING FINISHED PIPE.

CASTING PIPES IN PERMANENT MOLDS.

* Journal of the Franklin Institute.

the mold, or bring the cope side down to its place on the drag side, without shock, after the cores are set in place, and to open the mold or lift the cope after the pipe has been poured.

Between the closing device and the opening device is located a pouring device adapted to receive the molten metal from the cupola and pour it into the molds.

DESCRIPTION OF MOLD.

Each mold consists of a rectangular block of cast iron, approximately eighteen inches wide and eighteen inches high, by six feet long, parted on a diagonal line across the corners, and provided with hinges at the lower edge of the parting so as to allow the upper portion or cope to be swung up and back from the lower portion or drag. These molds weigh about 6,500 pounds complete.

(b) At the highest point of the barrel of the mold a small groove is cut, extending throughout the entire length of the barrel. This groove, which is quite small, being only one-eighth of an inch wide and deep, is intended to receive any gases or air which may be trapped in the mold, and so avoid the formation of flat spots at the top of the pipe. The resultant ridge not being prominent is not an objection, but rather adds to the strength of the structure.

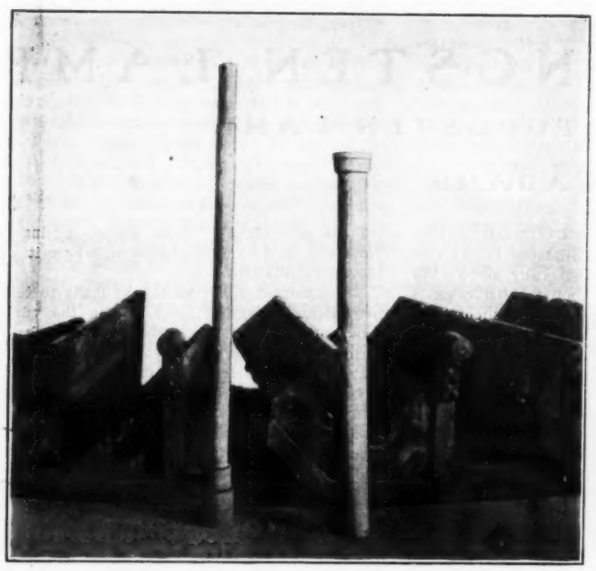
On one end of each mold is carried an arm rigidly attached to the upper or movable half. This arm extends under the mold and is of such form that when the mold is open it forms a rest for the movable half, holding it in such position as to allow of any work, such as setting cores, removing finished pipes, cleaning, etc. On the end of this arm is a steel roller

about three-quarters of an inch less in diameter than the inside diameter of the pipe. It is perforated throughout most of its length by small holes to allow any gases formed by contact with the molten metal to pass into the arbor and so have free vent to the air through the ends of the same.

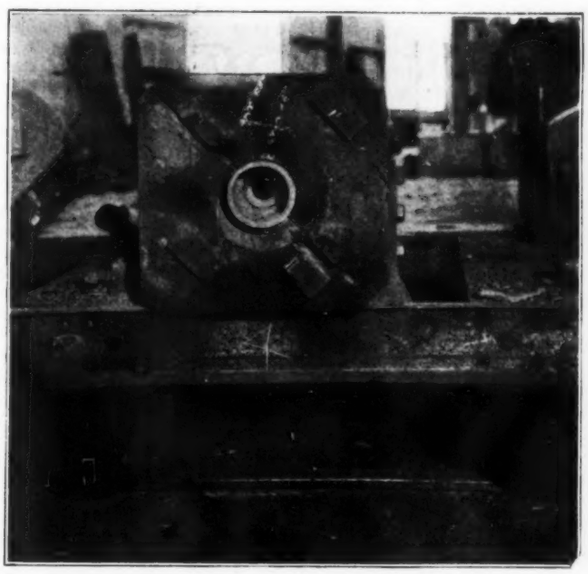
Each end of the arbor is accurately machined to fit the rings or bushings in the ends of the molds.

The core is made by placing the core arbor in the core machine, which consists of a support for the ends of the arbor, semicircular in form, and of a diameter to fit the arbor ends; a shaking screen arranged to sift sand, and a guide to drop it upon the arbor, and a knife, so shaped as to form the sand to the outline of the inside of the pipe.

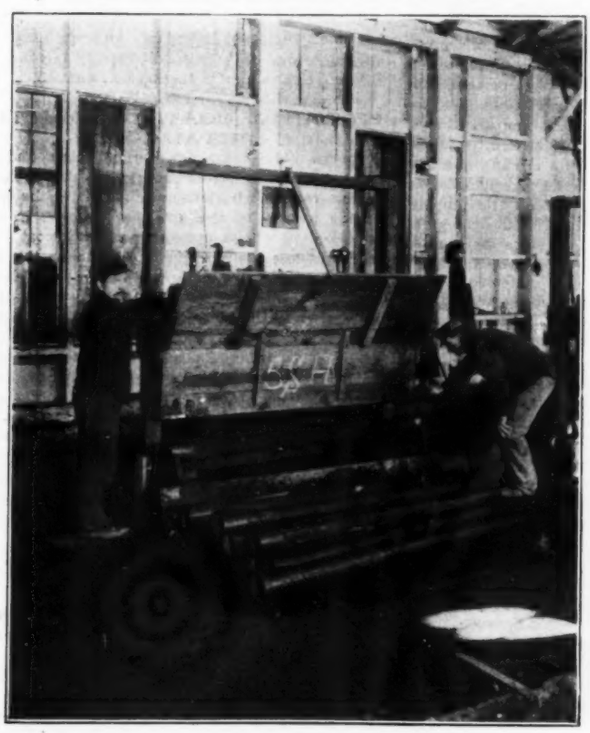
The core arbor, after being wet thoroughly, is placed



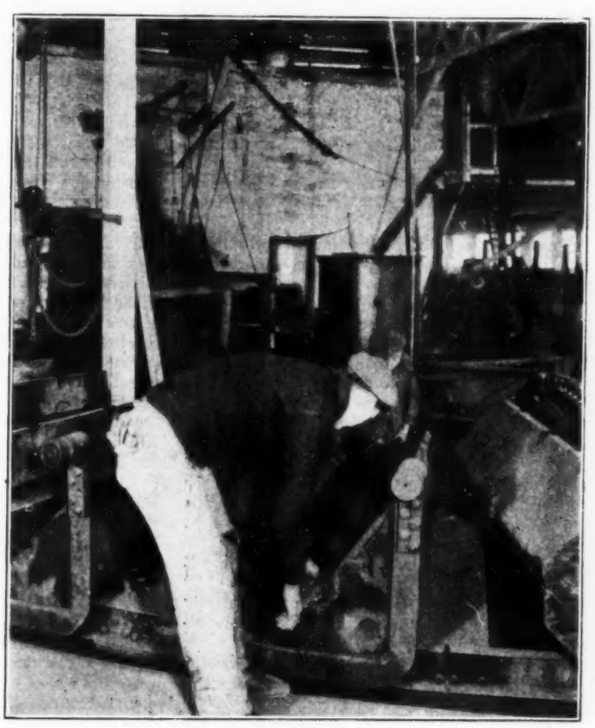
FINISHED PIPE AND CORE ARBOR. MOLDS OPEN.



CLOSED MOLD. CORE ARBOR IN PLACE.



MAKING CORES AND CORE MACHINE.



SETTING A CORE.

CASTING PIPES IN PERMANENT MOLDS.

At the center of the mold is the cavity into which the metal is to be poured to form the pipe. Thus one-half of the pipe is formed in the upper and one-half in the lower portion of the mold.

Gates are cut in the face portion of the lower part or drag of such size and shape as to receive the molten metal from the ladle and guide it into the mold. Three such gates are used, each dividing into two portions and so entering the cavity of the mold at six points.

(a) These gates are so shaped as to receive the shock of the falling stream of molten metal at a point outside of the mold cavity, and convey it into the mold quickly but gently, so that the core is not damaged by a rush of molten metal against it.

which is caused to travel down an inclined plane by the rotation of the table carrying the mold. This inclined plane is arranged to receive the roller at its higher position when the mold is open, and to guide it smoothly to its lower position, by this means closing the mold without shock or jar to disturb the core. This inclined plane constitutes the closing device.

Each end of the mold is provided with rings or bushings which are used to support the core arbor in a precisely central position in the cavity of the mold, so that the pipe when finished shall have uniform thickness of metal at every point.

The core arbor consists of a cast iron hollow cylinder somewhat longer than the pipe to be cast and

in the end supports and rotated by a crank-shaped piece of iron held loosely in one end by an operator. At the same time another operator shakes a sieve suspended over the arbor and previously filled with sand, tempered to the proper degree with water. This sieved sand is caused to fall directly upon the wet, rotating arbor and clings to it. The surplus sand is scraped away by a steel knife held at the proper distance from the arbor to make the finished core of the diameter and shape required. When sufficient sand is on the arbor to make a full and complete core (which requires about five seconds) the core is lifted from its supports and is ready for use. No further treatment of any kind is needed, and the core is placed in

position in the mold, which is then caused to pass the closing device, bringing the upper portion down in place and the mold is ready to receive the metal.

A ladle is provided to receive the metal as it flows from the cupola. This ladle is arranged so that it can take a position high enough to allow the molds to pass freely under it, or it can be lowered into a position between two adjacent molds, so that the pouring spouts are very close to the pouring holes of the mold. As the table rotates and brings a mold, which has passed the closing device, into pouring position, the ladle automatically drops into this latter position with the lips close to the pouring holes. The ladle is then tilted to pour by the operator, but in tilting it rotates around a center line which passes through the pouring lips, and hence the points of pouring do not move; and the streams of metal are guided directly into the pouring holes through the various gates into the mold and fill it completely, compressing any air or gas which may be trapped into the groove provided at the highest point for that purpose. If no gases are trapped, which, strange as it may seem, is usually the case, this groove is also filled with metal and forms a slight rib running the length of the pipe.

When the pouring operation is complete and operator tilts the ladle back, it automatically rises to its higher position so that the next mold may pass under it and assume the pouring position.

The mold being now filled with metal, is held long enough to allow the metal to set and then opened by passing the opening device, which is just the reverse of the closing device; the roller on the end of the arm or mold being guided up an inclined plane, thereby lifting the upper half or cope side, and swinging it away from the lower or drag side.

The pipe, which is still a bright orange color, is lifted from the mold and placed, after removal of the gates, with those previously cast, in piles, to cool slowly, when the core arbor is withdrawn and returned to the core machines to be used again.

After removal of the finished pipe from the mold, the loose sand which falls from the core during the handling of the pipe, and any other dirt, loose gates, etc., which may be left in the mold are swept out by air blasts or hand brushes and the mold is ready for another core and another filling with metal.

The method of pouring is very important; in fact, the success of the whole operation hinges very closely upon properly carrying out this scheme. By it is secured equal velocity and pressure of the molten metal as well as simultaneous action. Too much stress can not be laid upon this feature. The difference between a good pipe and a bad one is the difference between good and bad pouring.

TWENTY-WATT TUNGSTEN LAMPS.

THE FUTURE OF THE TUNGSTEN LAMP.

BY ALTON D. ADAMS.

Is HISTORY to be repeated by the use of 50-volt lighting circuits?

Tungsten lamps make it reasonable to think that 50-volt transformers and lighting circuits would benefit manufacturers, electric stations, and consumers, in many cases, by reducing the size and cost of the lighting unit.

Early in electric lighting, it was thought desirable to use 50-volt lamps, because shorter and thicker carbon filaments were the result. As the art of lamp making advanced, it appeared that 16-candle-power carbon filaments could be made at nearly equal costs for either 50 or 100 volts, and that the 50-volt filament showed no marked advantage in life or efficiency.

Regular practice therefore settled on 100 volts as the minimum pressure for 16-candle-power filament lamps, though lamps of lower candle-powers continued to be made for less voltages.

The advent of the tungsten lamp, with a filament whose length is a large multiple and whose diameter is a mere fraction of the like dimensions of carbon for the same candle-power and voltage, raises the question whether the standard electric pressure for the smallest size of this lamp for regular lighting purposes should not be fixed at 50 rather than 100 volts.

At the door of this inquiry comes the problem as to the candle-power to be taken as the standard lighting unit. On this point it is well to take a lesson from sociology, for the fixed wants and habits of a people are hard things to change, all at once, even with tungsten lamps.

From near the beginning of the incandescent lighting industry, and during half a century before that with gas, a lamp of 16 candle-power, more or less, has been the commonly accepted unit for the great bulk of interior illumination. Even the incandescent gas mantle, with an efficiency five times as great as that of the flat-flame burner, has been able to displace the open flame to only a moderate degree, in part because the mantle greatly increased the candle-power of the lighting unit.

It is not, then, a rash conclusion that there will continue to be a very large demand for lamps of about 16 candle-power, and unless the tungsten or some other filament of high efficiency can meet this demand, the gas jet and coal oil will continue to hold their established positions in the lighting field.

Lamp manufacturers and central stations can get their greatest benefit from tungsten lamps only by the extension of electric lighting, and not by merely connecting filaments of higher candle-powers into existing sockets.

At this time, in the United States, the 32-candle-power tungsten lamp is the smallest size generally made for 100-volt multiple circuits.

In Europe, tungsten lamps of 25 candle-power are in regular use on 100-volt circuits, and one company, at least, makes 100-volt tungsten lamps of 20 candle-power. Both of these last-named lamps are exported to the United States.

Even in the 32-candle-power 100-volt tungsten lamps, the filaments are so long and thin that breakage in transit and handling is an important item, and it is doubtful whether a 16-candle-power 100-volt tungsten lamp can be made commercially practicable.

For such a 16-candle-power 100-volt lamp, to operate with 20 watts, the filament must have twice the resistance of the 32-candle 100-volt filament, and must be correspondingly longer, thinner, or both. Assuming that such a filament is possible, its mechanical weakness, if not its cost, may make it impracticable.

The solution of the problem apparently is to make the 16-candle-power 20-watt lamp for some lower voltage, say 50, instead of 100 volts. A 50-volt, 16-candle filament operating with 20 watts is evidently nothing more than one-half of a regular filament for 32 candle-power and 100 volts, as now generally made. For the 32-candle 100-volt tungsten lamp the list price is $1.50, while the list price of the carbon filament lamp of 32 candle-power at 100 volts is 32 cents.

Evidently, the much higher cost of the 32-candle tungsten lamp is largely due to its filament, and if this filament makes two 16-candle lamps, the price of each should be materially below that of the 32-candle.

Low-voltage tungsten lamps are not a new thing for interior illumination, and they are regularly made of 6 to 20 volts each for series street lighting, so there is no doubt that they are entirely practicable. One manager of a central station reports the regular use of four 30-volt tungsten lamps in series for cluster work on 120-volt circuits, and one of the largest electrical manufacturers advertises a so-called reducing socket for 27½-volt tungsten lamps.

Neither of these expedients, however, can be regarded as more than a temporary makeshift, and the only permanent and satisfactory solution of the problem of distribution to the most efficient incandescent lamps, in small candle-powers, appears to be the adoption of about 50 volts on lighting circuits, as was formerly common for carbon-filament lamps.

The important factors to be considered in distribution to 50-volt lamps are the wiring circuits and the transformers. Where direct current is employed on distribution lines from central stations, the supply of 50-volt lamps in simple multiple circuits is probably impracticable; and if such lamps are there used, they must be connected in series of two, and then this series to the 100-volt mains.

The greater part of lighting from central stations is now done with alternating current, and with this current only the local and building circuits and the transformers need be considered. Standard makes of transformers have long been built so as to deliver either 50 or 100 volts on their secondary circuits, according to method of connection. On new work it will be easy to provide such transformers in all cases, but only a part of existing circuits have transformers of this type with 50 and 100-volt terminals. The transformers that deliver at least 100 volts, however, can gradually be shifted to locations where only lamps of 32 or higher candle-power are wanted, or else be rewound.

As to the local and building circuits, it is important to see that existing wires are not overheated, and that the volts lost in these wires between transformers and lamps are not so changed that unsatisfactory regulation at the lamps will result. To illustrate the effects of using 16-candle-power 50-volt tungsten lamps, the details of the electrical changes incident to their substitution on the existing circuits in buildings may be considered.

An interior circuit for the regular 16-candle-power, 100-volt, 50-watt, carbon-filament lamps may fairly be assumed to be designed for a drop of 2 volts in the wires, with all lamps burning. The 50-watt lamp at 100 volts evidently requires a current of 5/10 ampere.

If each 16-candle-power carbon-filament lamp be replaced with a 16-candle-power, 50-volt, 20-watt tungsten lamp, on the circuit just mentioned, the amperes per lamp will be reduced to 4/10, so that the heating of the wires will be less than before.

Volts lost in the wires will decrease in the same proportion as the amperes, that is by 20 per cent, or from 2 to 1.6, when the 16-candle-power tungsten lamps are substituted for the carbon filaments. There will thus be less fluctuation of voltage at the lamp terminals, due to changes in the number burning, with the tungsten than with the carbon filaments, but the percentage of volts lost in wiring to lamp volts will be 3.2 for the tungsten, where it was 2 for the carbon filament.

No important objection can be made to this higher percentage of lamp voltage lost in the wiring with tungsten than with the carbon filaments, because the former is much less sensitive to changes in volume of current, as to their effects on candle-power.

For each carbon-filament lamp connected, one watt will be lost in the wiring, and for each tungsten lamp 64/100 watt will be lost, under the conditions named. The above figures for the two lamps are grouped in the table.

Volts, Amperes and Watts in Wiring Circuits With 16-Candle-power Carbon and Tungsten Lamps.

Lamp.	Watts, Each.	Volts, Each.	Amperes, Each.	Volts Drop in Wiring.	Per Cent Volts Lost to Lamp Volts.	Watts Lost in Wiring per Lamp.
Carbon...	50	100	0.5	2	2	1
Tungsten.	20	50	0.4	1.6	3.2	0.64

PROTECTIVE COATINGS FOR POLISHED METAL GOODS.

COPPER, red-metal, brass, German silver and similar metals or alloys, withstand the effects of the atmosphere very poorly, inasmuch as, under the influence of the oxygen of the air, they become, in a short time, coated with a more or less thick coat of oxide, and thus lose their brilliancy. Although this stratum of oxide, especially in the case of alloys rich in copper, often produces beautiful effects that are very attractive to the eye, it is nevertheless desirable, in some cases, to preserve the original pure metallic colors or to retain, for some time, the brightness imparted to them by polishing, even where they are exposed to the air. For this purpose, the articles are coated with a colored or uncolored varnish. Under the title "varnish," we distinguish generally solutions of resins in alcohol or fatty volatile oils, and we distinguish therefore between spirit and oil varnishes. The latter are employed when an especially substantial and beautiful coating is desired, which it is wished shall be notably hard, durable, and brilliant. To the former, on the other hand, is given the preference, when the production of articles in quantities is the object; they are more readily applied and dry very quickly. They are used chiefly for copper and its alloys. In the production of the spirit varnishes we use shellac with or without the addition of sandarac, mastic elemi, copal, and benzoin. For gold varnishes the use of stick lac or seed lac is best. In the production of the fat oil varnishes we use, by choice, copal, amber, or rosin, to solutions of which shellac or sandarac is sometimes added. To obtain a golden-yellow varnish, a suitable addition of gamboge, aloes, dragon's blood, sandal wood, saffron, etc., may be made. With alcohol or oil of turpentine a deeply colored solution of these substances is produced and the spirituous tincture is mixed as required with alcohol varnish, the volatile with the fat or oil varnishes. A colorless varnish, for light colored goods in which it is desired to retain the natural color, is prepared by dissolving bleached shellac in alcohol. To bleach yellow shellac it is first dissolved in two parts of alcohol and this solution is poured slowly, in a thin stream and stirring vigorously, into a strong solution of chloride of lime. After bleaching, the lac is precipitated by the addition of hydrochloric acid, well washed out and dissolved, as usual, in alcohol.—Lexikon der Uhrmacherkunst.

HUMANE SLAUGHTERING FOR ABATTOIRS.

THE PRIZE CONTEST OF THE AMERICAN SOCIETY FOR THE PREVENTION OF CRUELTY TO ANIMALS.

THE Committee on Humane Slaughtering of the American Society for the Prevention of Cruelty to Animals has been actively engaged in obtaining a comparison of the methods employed throughout the world in slaughtering animals for food purposes with a view of recommending those which might prove the most humane and efficient for general adoption in this country. American invention has been stimulated by the announcement of a prize of five hundred dollars offered by the society for any device which might conform to the requirements of humanity, economy, and practicability.

It may be of interest to note briefly the methods of killing employed in various countries. In England the pole-ax is still extensively used, but is being superseded by modern shooting devices which include the "Humane Killer" made by the Royal Society for the Prevention of Cruelty to Animals, and the "Greener Humane Cattle Killer." Both are pistol devices. The "Humane Killer" is attached to a handle or pole so that the person operating it need not closely approach the animal. The "Greener" device has a projecting firing-pin, which causes an explosion on being struck with a mallet. Small animals are usually stunned by a blow on the head from a club or hammer before bleeding.

The Bruneau slaughtering mask is generally used in France. A leather mask to cover the head supports a metal socket with a sliding bolt so placed as to be directly over the cerebrum and a blow from the mallet causes the pointed end of this bolt to penetrate the brain.

In Spain, Cuba, and many Latin-American countries, cattle are usually stabbed with a species of dagger; the blow being delivered from above and just back of the horns. This produces paralysis without destroying consciousness and is condemned by experts as cruel.

The Shecheta mode of killing consists in bleeding to death and requires that the animal should be cast or hung up by the hind legs before the knife is used. This practice prevails also in all Mohammedan countries. Great and needless suffering is caused by the method of slinging the animal in this country as the packers claim that the European method is too slow.

The greatest results in the humane destruction of food animals have been accomplished in Germany, where the government experts fully respect the right of an animal to a merciful death and at the same time safeguard public health by a careful supervision of the sanitary conditions in the abattoirs, as well as the systematic inspection of meats and other products.

As one of their officials has aptly remarked, "The abattoir directors have marched with the times."

In Denmark, Switzerland, and some of the German states the use of the knife, without previous stunning of the animal, is prohibited by law.

In abattoir work in this country, as in all other classes of business, competition enforces economy of production.

The object the society had in view in offering a prize of $500, as set forth in the SCIENTIFIC AMERICAN, was to stimulate inventive genius to produce some new apparatus which would be better than those at present in use, and fulfill the requirements of humane slaughtering. In the opinion of the committee none of the devices submitted in this competition meets these conditions as fully as the shooting-bolt weapons which have been in use abroad for a number of years and which are giving complete satisfaction, according to advices received from numerous abattoir directors, veterinarians and others most competent to judge.

The committee therefore recommend that the Society's gold medal be awarded to the "Behr" Waffenwerke G. m. b. H. in Suhl, makers of the Behr pistol.

For substantial progress from the humanitarian point of view, we must therefore return to Germany, where some years ago prizes were offered for the best devices for humane slaughtering, as well as for the best essay on that subject. In the "Bolza Competition" a sum of $1,250 was offered for a humane slaughtering invention adapted to commercial purposes. One hundred and eighty-three competitors appeared and of the devices submitted 28 possessed substantial merit. The committee consisted of abattoir directors, veterinary surgeons, wholesale butchers, and representatives of the anti-cruelty societies. After public tests at the Leipsic abattoir, in 1902, the first prize of $750 was awarded for a bolt-shooting apparatus submitted by the Eagle Small Arms Company; the second prize being given to Mr. Flessa for his bolt-shooting invention. For two years experiments were conducted along these lines and among the devices thus brought out is the "Behr" pistol, recommended by German experts to-day as the most perfect in its operation for producing instantaneous insensibility. In 1904 a prize of $250 was awarded to Hugo Heiss, director of the abattoirs at Straubing, and president of the South German Municipal and Abattoir Veterinarians, for his essay: "Humane Slaughtering," which has now appeared in an English translation.

In regard to the "Behr" apparatus Herr Heiss wrote the committee in response to inquiries made: "We have to-day throughout Germany about 700 modern slaughter houses, in which slaughtering with the shooting apparatus has been introduced and successfully practiced for many years, after a hard and energetic propaganda with our slaughter men, who are to-day universally satisfied with the methods. . . . Since their introduction in 1904 the bolt-shooting weapons have been used extensively and have given perfect satisfaction. The bleeding out occurs faultlessly and the preservation of the meat is at least as good as with former methods. All assertions to the contrary are untrue and uttered without experience. The wildest cattle can be killed perfectly with the "Behr" system of shooting apparatus. There is no death struggle and the animal drops to the ground without uttering a sound."

As a result of voluminous correspondence and practical observation, the committee reports the following findings:

1. That all animals should be stunned before being subjected to the bleeding operation.

2. That the "shooting-bolt" weapon should be used for the stunning of cattle, horses, and, as far as practical, the smaller animals.

(*a*) On account of its great efficiency in producing instantaneous insensibility, through the explosive force exerted by the discharge on the cerebrum.

(*b*) The relative absence of danger to human life in its use; there being no bullet and consequently no risk from stray or deflected missiles.

3. That if, for economical reasons, the shooting-bolt apparatus be not employed for small animals; calves, pigs, and sheep should be stunned before bleeding by a blow from a special form of club having an iron knob at the end. In stunning calves and pigs the blow should be aimed at the forehead; but, in the case of sheep, it should be delivered just back of the ears. A form of stunning apparatus, for small animals, which has given most satisfactory results in hundreds of slaughtering establishments, and known as the "striking-bolt" instrument, of which the Kleinschmidt and Kurten are the best examples, is especially recommended on account of its humaneness; the only objection being that this device requires more delay and the employment of an extra man in its operation.

4. That the public abattoir system of Germany under the supervision and direction of expert government officials of intelligence and experience, not only conserves the interests of humanity; but, constituting as it does, through the resulting rigid inspection of all meats and other products, such a reliable safeguard to the public health and safety, should be universally adopted.

5. That their public slaughter houses, which were designed with an especial view to the humane handling and slaughtering of animals as well as providing the most complete sanitary arrangements, should serve as models for the construction of such buildings in America.

6. That, in view of the national importance of this question, an appeal should be made to the United States government to send a commission abroad for the purpose of investigating and reporting on the abattoir systems of Germany and other foreign states.

ANTHRACENE AND ITS PRODUCTION.

ANTHRACENE, which occupies such an important place in the coloring matter industries, was discovered in 1832 by Dumas and Laurent. In 1866 Limpricht prepared it by synthesis, and in the same year Berthelot showed its formation by means of tubes heated to redness and the method of extracting it from coal tar. Its principal use is for the fabrication of alizarine, and the annual production of this latter for the entire world is 16,000 tons. One of the leading German factories which use anthracene has a capital of $5,000,000 and employs 145 chemists and 5,000 workmen, and there are several other establishments in the country which are not far below this. As regards the preparation of anthracene, it is deposited in the form of a thick greenish semi-liquid mass by the cooling of the anthracenic oils coming from coal tar. Such oils are collected during the distillation by means of very large sheet-iron tanks, and in the case where the distilling process uses water for drawing over the vapors of distillation, the process commences by the separation of the water, this being condensed in the upper part of the apparatus. By means of a stopcock placed in the lower part of the tank we can draw off a certain part of the liquid when the mass has become well cooled. This operation is, however, too long and it gives but inferior results in large factories. In order to separate the oils, the temperature must be below 10 deg. C. During the summer the anthracene remains almost entirely in solution with the oils, and if we desire to separate it the tanks must be placed in the cellars, where they are kept cool. When the anthracene is well deposited, the oil forms about 60 per cent of the contents of the tanks. The filtration process is also used for obtaining the anthracene, and it can be separated by cloth filters in the form of sacks, but the quantity of such filters which is needed is too large, and there is too much time taken for the filtering operation. This method is used in the smaller factories, and the resulting product contains a large proportion of oil and has only 10 per cent of pure anthracene. A better result is secured by the use of a suction filter, that is, by using a box with a filter cloth and making a vacuum in the lower part beneath the filter. When there is a large quantity of the oily product to be filtered, a centrifugal machine driven by a motor is used. Its speed should be at least 1,000 revolutions per minute and often it exceeds this amount. A filtering cloth prevents the escape of the anthracene. When the machine is full of anthracene, the containing vessel is emptied. In this way there is a great loss of time and the amount of oil which is filtered is not large enough. Moreover, the anthracene which is obtained with the centrifugal apparatus is not more than 15 per cent pure. The best method of separating the anthracene from the oils in the large establishments consists in the use of the filter press. These presses are composed of a number of cast iron chambers containing numerous holes and separated by thick cloth. A pump takes up the oil and anthracene from the tanks and sends it into the chambers of the filter press. A pressure gage shows the number of atmospheres pressure and when the filter press reaches 10 atmospheres the pump is stopped. All the anthracene is deposited in the chambers of the filter press, and each operation lasts for half an hour. The plates are then unbolted and the pressed product removed in cakes of 1 inch thickness and 20 inches square. The production of anthracene varies with the number of chambers of the filter press, giving 500 pounds per day with a filter press of three chambers up to 5,000 pounds per day with thirty chambers. The anthracene which is thus obtained is about 25 per cent pure and this will vary more or less according to the fractional distillation of the oils and also the source of the products.

THE SUPPLY OF URANIUM.

IT might be expected that the concentration of the heaviest element known to us (uranium) at the surface of the earth is just what we would not have expected. Yet a simple enough explanation may be at hand in the heat-producing capacity of that substance. If it was originally scattered through the earth-stuff, not in a uniform distribution, but to some extent concentrated fortuitously in a manner depending on the origin of terrestrial ingredients, then these radioactive nuclei, heating and expanding beyond the capacity of surrounding materials, would rise to the surface of a world in which convective actions were still possible, and, very conceivably, even after such conditions had ceased to be general; and in this way the surface materials would become richer than the interior.

Taken all together, the case stands thus as regards the earth. We are assured of radium as a widely distributed surface material, and to such depths as we can penetrate. By inference from the presence of radium in meteoric substances, and its very probable presence in the sun, from which the whole of terrestrial stuff probably originated, as well as by the inherent likelihood that every element at the surface is in some measure distributed throughout the entire mass, we arrive at the conclusion that radium is indeed a universal terrestrial constituent.

The dependent question then confronts us: Are we living on a world heated throughout by radio-thermal actions? This question—one of the most interesting which has originated in the discovery that internal atomic changes may prove a source of heat—can only be answered (if it can be answered) by the facts of geological science.

THE REMODELED "ZEPPELIN III." AIRSHIP.

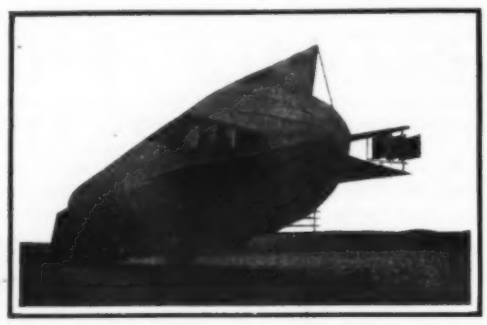
DESCRIPTION OF THE FIRST FLIGHTS SINCE THE CHANGES HAVE BEEN MADE.

BY DR. HUGO ECKENER.

THE airship with which Count Zeppelin began a series of experiments on October 23 last is the reconstructed and somewhat altered craft that already, in 1906, and again in 1907 was tried successfully. It is the first model with stabilizing planes at the rear and the one which, on the 9th and 10th of October, 1906, astonished everyone because of its easy and steady flights. When in 1907 it was tried again, it was improved by changing the position of the steering apparatus from below to above on the sides. The placing of the horizontal rudders on the sides of the balloon made them much more effective than before, chiefly because they were enlarged. But the vertical rudders placed between the stabilizing surfaces were not quite satisfactory. Turning to starboard especially was accomplished very slowly. On the fourth trip, it will be remembered, Count Zeppelin experimented a long time with the side steering. The final solution of this consisted in the rigging up of a huge rear rudder and in the removing of the small side surfaces to the ends of the stabilizing planes. In reconstructing the third airship, an effort was made to improve it still more. The large rear rudder, which was too heavy for the smaller vessel, was done away with, and the side vertical rudders were increased in size and brought to the rear, triple rudders being used instead of double ones, as heretofore. Moreover, the two side rudders are operated separately, so that in case of the breakage of one the other can be used.

Besides the changes of the vertical rudders, the reconstructed airship has been lengthened 8 meters by a new section fitted in the middle, which increases its capacity about 900 cubic meters (31,500 cubic feet) and gives it 500 kilogrammes (1,100 pounds) greater lifting capacity. The length of the airship is now 136 meters (446 feet), which is the same as was that of the destroyed No. 4, and the diameter is 11.7 meters (38.37 feet). The motors are the old ones of about 80 horse-power each.

The first trial of the remodeled airship, which had been planned for October 20, was necessarily postponed several days on account of a strong northeast wind which made it impossible to bring the airship out of its inconveniently situated shed. On the afternoon of October 23, however, the weather was better, and consequently the huge air craft was drawn out of its shed above the floats, which were towed out a short distance in the lake. The ship was then lightened by about 100 kilogrammes (220 pounds) and it immediately arose quickly from the narrow bay and passed over the land. The extraordinary stability of the long airship was at once apparent as soon as it ascended and the propellers began to work. Although it has been enlarged, this did not seem to affect the stability, which was now absolutely perfect. There was no dodging from side to side, nor was there any plunging, but the huge vessel remained quite horizontal. In this respect, it is the best model that has thus far been tried. The reason for this



REAR END VIEW OF THE REMODELED "ZEPPELIN III."

Note the triple vertical rudders on each side between the inclined stabilizing planes; also the quadruple horizontal rudders.

improvement in stability doubtless lies in the addition of the middle section which brought the weight of the cars considerably nearer the ends. The second model showed the same improvement, but with a larger diameter and consequently with a greater total weight.

The slight pitching of the airship around its transverse axis did not amount to much on account of its great stability. The horizontal rudders worked better than ever before, the vessel responding to them very readily.

Also the second improvement, the changing of the vertical rudders, was a very good one. The airship responded easily to each slight movement of these rudders, and maneuvered to port or starboard with either one or two motors operating.

It was impossible to make exact measurements of the speed because Count Zeppelin continued experimenting with the rudders.

In addition to its load of ten people, the airship carried 2,200 pounds of gasoline, 600 pounds of lubricating oil, and 2,200 pounds of water ballast. The weather was cold and disagreeable with a fresh north wind.

The airship was in charge of young Count Zeppelin and Engineer Duerr. In the rear car was the son-in-law of Count Zeppelin, Lieut. Von Brandenstein. The trip extended first to Friedrichshafen, then back and forth over Lake Constance and the places along its shore, and it was terminated only by the approaching darkness after the airship had been operating for three hours.

In landing, an attempt was made to descend close to the shed, but a mistake was made in judging the distance. Ballast was quickly thrown out and the airship rose in time to avoid hitting the shed. Afterward gas was let out again and the airship descended gently and was finally housed without damage.

On the following day, October 24, the second trip was made. This lasted about one and one-half hours, during which time the airship traveled back and forth between Constance and Friedrichshafen. The horizontal rudders were operated and found to work very well. It was found that the ship could be maintained in a horizontal position at any height desired by setting these rudders horizontal while the vessel was under way. The landing was accomplished successfully at the end of this trip, the airship descending almost directly in front of its shed.

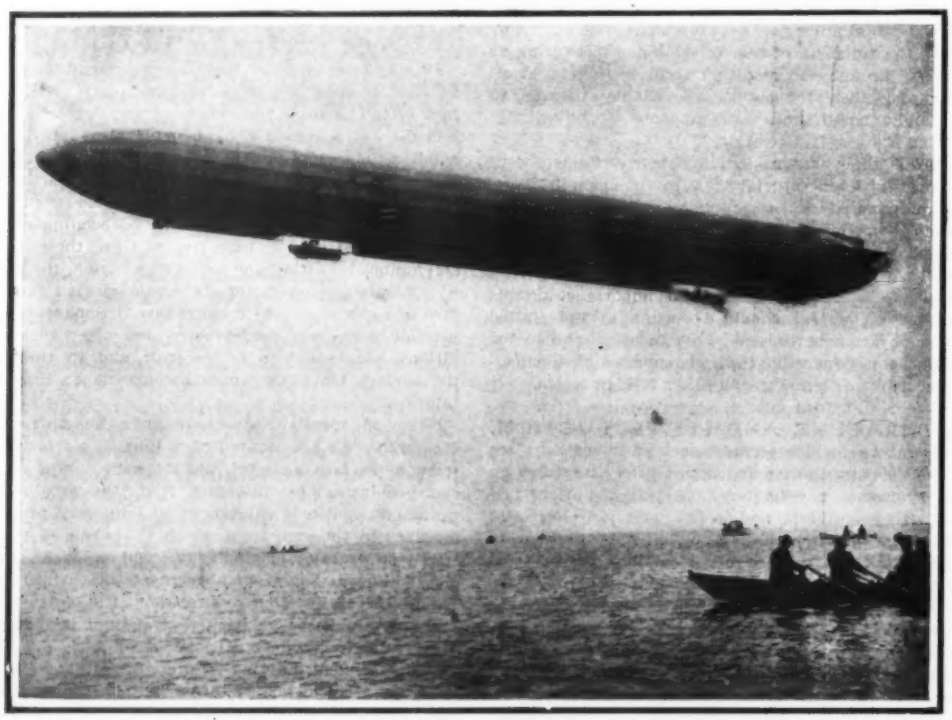
On Monday, October 26, Count Zeppelin himself was in the forward car. He made a test flight to see that everything was all right before the journey the following day, when he expected to take up Prince Henry of Prussia. Everything worked satisfactorily on this trip. The weather was fine and there was practically no wind.

The following day was one of the greatest for Zeppelin and his airships. Shortly after 11:30 A. M., Prince Henry and the King of Württemberg arrived at the balloon shed. After being greeted by the gentlemen present, Prince Henry climbed into the forward car with Capt. Mischke and the command was given to start. In two minutes' time the airship had been withdrawn from its shed, and in another two minutes it was high in the air and in full flight toward the west. It had been planned to make a trip to the falls of the Rhine at Schaffhausen. The start was made as punctually and readily as with a railway train. At Immenstaad, Lake Constance was left in order to pass over Markdorf and to travel above the land, but there was such a thick fog over the land that above Meeresburg the vessel again passed out over the lake. The greater part of Ueberlinger Lake was flown over, the ship being steered by compass. Singen and the Hohentwiel were reached and passed, and finally, after a 2½-hour trip, the airship made a circle at a slight elevation above the Falls of the Rhine. The course was then laid homeward over Constance, Romanshorn, Rohrschach, Bregenz, and Lindau to Manzell, where, after a 6-hour voyage, the airship at length arrived safely.

Nothing went wrong throughout the entire trip. The motors, the steering apparatus, and all the other machinery were constantly watched and consequently gave no trouble. In six hours the airship had traveled about 250 kilometers against a wind that was sometimes quite strong, especially at the beginning of the trip and above the mouth of the Rhine. Prince Henry was delighted and enthusiastic over the voyage. He himself worked the vertical rudders for awhile, and also noticed how the airship was navigated with the compass and barograph. "This is no longer a balloon, but a real ship," he exclaimed in astonishment. He told Count Zeppelin that he too, like so many others, had believed the Count to be crazy, but that for some time past he had rather changed his opinion, and that from now on he would be a staunch supporter of the airship. The trip with Prince Henry was one of the greatest things that has yet happened for the aiding of Count Zeppelin and his air craft.

On the 29th of October, the fourth voyage was made with Herzog Albrecht von Württemberg on board. The airship started out in the golden rays of the sun and passed over Württemberg and then over Ravensburg and Weingarten to the Waldsee, and from there along the railroad line to Lindau and thence back to its shed. The trip lasted three hours and was not terminated until dusk. Everything worked satisfactorily and nothing especially new was learned; but from a highly asthetical point of view, the return of the ship at night, when it came ghost-like through the air and appeared out of the silvery fog like a phantom, putting itself in communication with the balloon house by means of flashlight signals, was very remarkable.

Subsequently to the flights above described, Count Zeppelin, on November 9, with the Crown Prince of



THE LATEST ZEPPELIN AIRSHIP—THE REMODELED NO. 3—IN FLIGHT ABOVE LAKE CONSTANCE.

The large vertical rudder at the rear has been dispensed with and replaced by small triple rudders on each side.

THE REMODELED "ZEPPELIN III." AIRSHIP.

Germany as a passenger, made a flight to Donaueschingen. The airship arrived shortly before the Kaiser's train from Vienna, and when the Kaiser alighted from his private car, he conversed with the Crown Prince in the airship above through a megaphone. During his drive to Prince Fuerstenberg's castle the airship followed overhead and then proceeded on its return journey to Friedrichshafen. The total distance, which was between 50 and 60 miles, was covered at a speed of between 30 and 35 miles an hour.

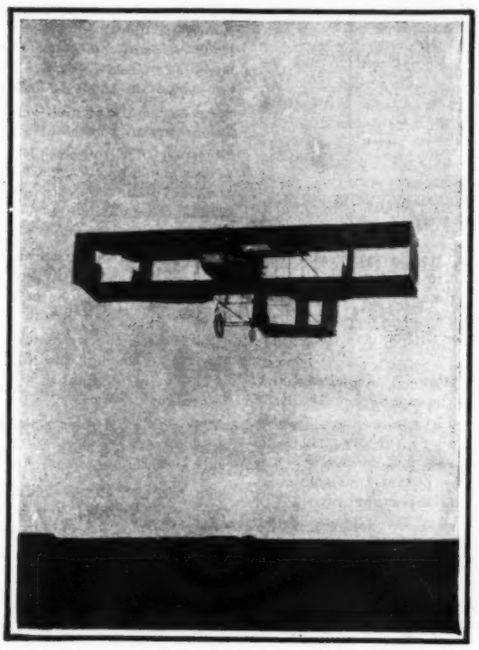
On the outward journey, the airship was delayed somewhat by fog and at one time it narrowly escaped scraping the tops of some trees. The Crown Prince steered the airship during part of the journey.

The following day the Kaiser himself visited Friedrichshafen. It was thought that he would make a flight with Count Zeppelin, but instead he watched the airship from a boat on the Lake, while he deputed Prince Fuerstenberg and his adjutant, Herr Von Seiden, to try the craft in his stead. In the second flight Major Gross and the Princess Fuerstenberg ascended. The Kaiser was greatly pleased with the performance of the remodeled airship, and after it was over he conferred upon Count Zeppelin the Order of the Black Eagle, and lauded him as being the greatest German of the twentieth century. The airship was placed in charge of Major Gross, the inventor of the Gross dirigible, as it has now been acquired by the German government, and further experiments with it will be made by the military authorities.

FIRST CROSS-COUNTRY AEROPLANE FLIGHTS.

THE LONG-DISTANCE FLIGHTS OF FARMAN AND BLERIOT IN FRANCE.

ABOUT 5 P. M. on the afternoon of October 29, Henry Farman made a short flight above the military camp at Chalons, France. The flight was terminated by a leak in the gasoline tank, which obliged the aviator to descend after he had been aloft only about two minutes. Repairs were made and everything was got in readiness for the record flight of the following day, which Farman had determined should be from one point to another across country.



FARMAN'S AEROPLANE FLYING ACROSS COUNTRY.

Note the vertical partitions connecting the planes. These have been added recently.

On October 30 Farman brought out his aeroplane at 3:40 P. M., and placed it on one side of the military field, at the left of the central road. After a few preliminary arrangements had been made, the engine was started, and the machine ascended at 3:50 P. M., and flew in a straight line in the direction of Reims, rising to an altitude of from 130 to 160 feet. It went high over the trees, and was soon lost to view beyond the horizon. The inhabitants of the various villages on the route followed were greatly astonished to see this huge bird-like machine passing over their heads, and many a cheer was sent up to the daring aviator as he continued on his record-breaking flight.

At 4:10 P. M. exactly the aeroplane landed easily upon a field near the wine cellars of the well-known Pommery firm at Reims, a distance of 27 kilometers (16.75 miles). The speed of the flight was 73 kilometers (45.36 miles) an hour. Immediately upon alighting Farman was greeted by his brother Maurice, and he and Gabriel Voisin (the constructor of the aeroplane) received a great ovation from the populace.

It was Farman's intention to return to Chalons in the same way in which he came; but the fatigue that he felt after making this first cross-country flight, and also some slight repairs which it seemed necessary to make to the motor, caused him to give up this plan, and to take his machine apart and return it on a truck.

The following day Farman reassembled his machine at Chalons, and attempted to win the prize for height given by the journal l'Auto. He had no difficulty in crossing the line of small balloons located at a height of 30 meters (98.4 feet). Unfortunately, however, some days after the flight it was found that the distance of the balloons above the ground had not been accurately measured, and so the prize was not officially won by Farman after all.

The accompanying map shows the course followed by Farman in this first cross-country aeroplane flight that has ever been made. By looking at this map, the reader will see that the aviator followed the roads and the railroad a good part of the way. The frontispiece of the November 21 issue of the SCIENTIFIC AMERICAN shows him sailing high above a house and passing close beside a church steeple in one of the villages above which he soared.

After numerous accidents, and after his machine had been repaired subsequent to its latest smash a few days before, M. Louis Bleriot on October 30 resumed his experiments near Toury. A great crowd had collected to watch him, and it was after 10 o'clock in the morning before he was able to get sufficient room in which to make an ascent and maneuver without the danger of hurting anyone in case he should come down unexpectedly. After having flown only 125 feet the aeroplane dove to the ground and was considerably damaged. The mechanics had connected the wrong wires to the horizontal rudder, so that when the aviator attempted to rise he descended abruptly. He was not hurt in the least, but his machine was considerably damaged. He returned to Paris, and left his two mechanics to make repairs.

MAP OF COURSE FOLLOWED BY FARMAN IN HIS 16¾-MILE CROSS-COUNTRY FLIGHT.

These were completed by the following morning, and by noon of October 31, Bleriot ascended with the idea of making a circuit above the village of Semondville, turning above a wood, and returning above Janville to his shed. He made this flight successfully in 4 minutes and 5 seconds; and, encouraged by it, he decided to try to beat Farman's record of the day before. Consequently at 2 minutes after 3 in the afternoon, he started before a tremendous crowd in the direction of Artenay, a village about 9 miles distant.

FARMAN'S AEROPLANE, SHOWING SOME OF THE RECENT CHANGES IN ITS CONSTRUCTION.

Vertical partitions have been placed half way between the center and ends, and also at the ends of the main planes. They prevent the machine from skidding sideways when turning a corner.

which he had chosen as his turning point. He had sent a photographer to this place, with instructions to send aloft some small captive balloons, so that he would know where to turn, but unfortunately the balloons refused to ascend, and Bleriot passed by the spot and afterward descended for a few minutes. He made some slight repairs to the magneto, and then reascended readily again, turned around, and headed for home once more. A second stop was made near Santilly, but this too was only of a few minutes' duration. The course followed and the stopping points can be seen by a glance at the map of Bleriot's flight, which we reproduce.

The flights made by Bleriot, who covered a total distance of 28 kilometers (17.38 miles), were even more remarkable than the one made by Farman, since he landed twice *en route* and rose again successfully, and also since he accomplished these flights with a monoplane, which is a faster and more advanced type of machine than Farman's. The speed attained varied between 75 and 85 kilometers (46.6 and 52.82 miles) an hour.

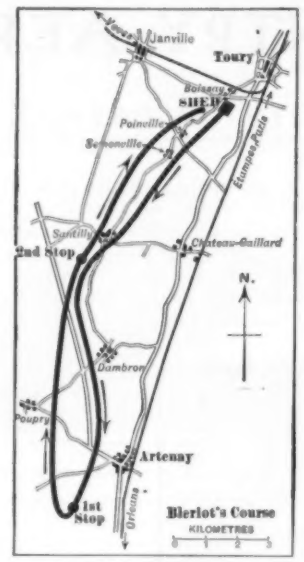
These two cross-country flights of Messrs. Farman and Bleriot open a new era in the history of aerial transport by heavier-than-air machines. The two aerial pioneers deserve the greatest credit for having demonstrated the feasibility of flying from one point to another when desired. The risks which they ran were very great, as everything depended upon the reliability of their motors. Both motors were of the 8-cylinder water-cooled type, capable of developing 50 or 60 horse-power. The aeroplanes weighed 1,000 to 1,200 pounds each, and that they were fairly efficient can be seen from the high speeds at which they flew. Since the demonstration by these two men, there has been a large number of cross-country aeroplane races announced for next year. Altogether, nearly $350,000 in cash prizes has been put up for competition abroad, and a partial list of some of these is given below.

On November 4, M. Bleriot expected to make a new long-distance record. In the morning he several times circled around the field at Chalons, and in the afternoon he was practising some more, when suddenly the aeroplane turned a somersault and landed heavily upon the ground. M. Bleriot, as usual, emerged from the debris unhurt. The aeroplane was a complete wreck. Instead of reconstructing it, Bleriot is now building a double-surface machine somewhat similar to Farman's. He has evidently come to the conclusion that the monoplane is too unstable and dangerous a machine to experiment with further.

RECENT AEROPLANE PRIZES AND THE CONDITIONS UNDER WHICH THEY MAY BE COMPETED FOR.

The International Sporting Club of Monaco has offered $20,000 in cash prizes to be competed for by aeroplanes between January 24 and March 24, 1909. The aeroplanes will be required to start from the main quay, which is 400 yards long by 40 yards wide, and to fly across the Bay of Hercules, circle around Cape Martin, and return to the starting point, a total distance of 9.6 kilometers or 5.87 miles. The competitors may make as many attempts as they wish between these dates, provided they notify the committee by 9 A. M., and make the flight between 10 A. M. and 5 P. M. Arrangements will be made to officially observe all flights made between these hours. The machines making the three best times for the course will be awarded the first, second, and third prizes of $15,000, $3,000, and $2,000. In case there are not sufficient machines to win first, second, and third places, or in case no machine makes the flight, the committee may award a certain sum to the various contestants in order to aid them. Sheds will be provided for the storage of the machines. The aeroplanes can be launched in any suitable manner, but they must be provided with floats to support them in case they descend into the water.

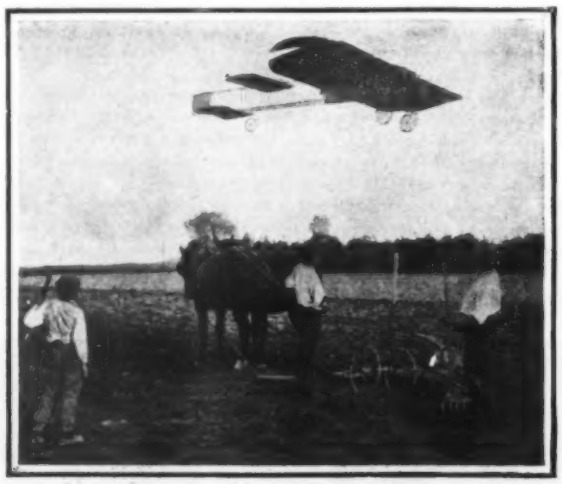
The Pommery prize consists of a cup valued at $10,000 which has been given to the National Aerial League by the well-known wine firm of Reims. This cup is to be competed for continuously, and it will be awarded every six months to the aviator who has made the longest flight in a straight line up to that time. Should anyone fly the distance of 1,000 kilometers (621 miles) in less than five hours, before three years have expired, such aviator will become the owner of this cup.



MAP OF BLERIOT'S 17.38-MILE CROSS-COUNTRY FLIGHT, SHOWING STOPS MADE EN ROUTE.

The Grand Prize of the National Aerial League ($4,000) will be awarded to the winner of an aeroplane race of 20 kilometers (12.43 miles) which will be flown in a closed circuit above the aerodrome of Savigny-sur-Org. The contestants will be started one after the other. The one who covers the course in the least time without touching the ground or any of the marking posts will be declared the winner. A flying start will be required, the competitors being allowed 1,500 meters (4,920 feet) in which to get up speed and rise in the air. Three attempts to start will be allowed. In order to qualify for this event, foreign aviators must have resided in France for at least two years.

Other prizes of the National Aerial League to the amount of $4,000, consist of twenty $200 cash prizes for various small events.



BLERIOT'S MONOPLANE ON ITS 17-MILE CROSS-COUNTRY FLIGHT.

Despite numerous accidents, this machine has proved its worth by its flights across country and in a strong wind.

THE FIRST CROSS-COUNTRY AEROPLANE FLIGHTS.

L'Auto of Paris has offered a prize of $2,500 for an aeroplane race from Bordeaux to Paris. This race will be run under the rules of the International Aeronautical Federation. It is to be conducted in five daily stages, as follows: Bordeaux to Angouleme, 105.64 kilometers (65.65 miles); Angouleme to Poitiers, 105.5 kilometers (65.55 miles); Poitiers to Tours, 95.91 kilometers (59.59 miles); Tours to Orleans, 111.2 kilometers (69 miles); and Orleans to Paris, 111.25 kilometers (69.2 miles). This makes a total distance of 529.5 kilometers (328 4-5 miles) as against 592 kilometers (368 miles) by road. M. Bleriot is of the opinion that it will be possible to run the race within the next eighteen months. He believes that if the race were made continuous, the entire distance could be covered without a stop in five or six hours. The only thing that prevents the accomplishment of such a performance at the present time is the unreliabifity of the motors. M. Bleriot believes that Wilbur Wright could cover the distance now were he to try.

La Petite Gironde, one of the Bordeaux newspapers, in addition to the $200 aviation prize which it had previously offered to the National Aerial League, has just offered another prize of $2,000 to the first aviator who, starting from the Place des Quinconce at Bordeaux, will fly around the church steeple at Cenon, situated 3,600 meters (2¼ miles) from Bordeaux, and return and alight at the starting point. The total distance is about 7.2 kilometers (4½ miles). This prize will be controlled by the Aero Club of the Southwest.

The Aero Club de l'Oise has decided to conduct a race, next year between Compiègne and Paris. A substantial prize will be offered. A stop will be made at the half-way point, either at Chantilly or at Senlis. It is expected that the various towns on the route will aid in raising the money for this prize.

Another race from Pau to Biarritz and return is being talked of by the mayors of these two towns, who propose to offer a prize of $4,000 to the aviator who makes the fastest flight. The distance between these two places is about 50 miles.

An aeronautic exhibition and competitions for prizes amounting to a total of $20,000 will occur at Cannes, starting from the first of January. The exhibition will be held in the Place des Allées, and the airship and aeroplane contests above the racecourse at Napoule. There will also be a congress of aviation societies.

The prize of the General Council of the Seine, which has been offered at the suggestion of M. Virot, is for $1,000. The conditions of this prize have not yet been announced.

La Nature, the well-known French scientific journal, has offered through the National Aerial League a prize of $2,000 for a flight of 100 kilometers (62.1 miles) in a straight line.

The city of Bagneres-de-Bigorre has offered a prize of $1,400 for the first flight from that city to the Chateau of Artigues, near Cripp.

M. Alphonse Talco has offered a prize of $2,000 for the quickest flight from the military camp at Chalons to the parade ground at Issy-les-Moulineaux.

The largest single prize at present available is one that was offered two years ago, and that up to the present time has never been competed for.

The London Daily Mail prize of $50,000 is for an aeroplane flight of 160 miles from London to Manchester. Contestants must start from a point not more than 5 miles away from the office of this newspaper in London, and land within 5 miles of the Manchester office. One or two stops will be allowed *en route* if these are found to be necessary. This is the largest single prize for a cross-country flight. It is probable that Henry Farman will compete for it in the near future.

The Michelin prize of $20,000 is for a cross-country flight by an aeroplane carrying two people from Paris to the top of the Puy de Dome, a mountain 4,775 feet high about 220 miles distant. The machine must circle the Arch of Triumph at the start, and the church spire at Clermont-Ferrand near the finish. The flight must be accomplished in six hours, or at an average speed of 36 miles an hour. This prize was offered for competition last spring. The offer holds good until the end of the year 1918.

Other Michelin prizes amounting to $32,000 consist of $4,000 a year for eight years to be given to the aviator who makes the longest flight in a closed circuit each year in any country, provided the flight is made under the official observation of a committee of an aero club belonging to the International Aeronautic Federation. The longest flight this year thus far—something over 50 miles—was made by Wilbur Wright in France, so that this leading American aviator will probably be declared the winner for the first year.

The Automobile Club of France has appropriated $40,000 for prizes for an aeroplane race next year. The rules governing this race have not yet been drawn up, but it will probably be a cross-country event.

The French Government appropriation for the encouragement of aviation, which was only made last month, is $20,000. This appropriation, it is expected, will be used chiefly for prizes for contests to take place next year. The government will doubtless add to it later on.

The prizes for flights across the English Channel total $10,000. The chief of these ($5,000) is that

offered by M. Henri Deutsch to the aviator who will fly across the Channel from France to England with Col. Renard as a passenger. The London Daily Mail offers $2,500, and the firm of Ruinart Frères offers the same amount for the performance of this feat by an aviator alone. The Ruinart offer was made in 1906, and holds good until January 1, 1910, the only stipulation being that the flights should be made on the second and fourth Saturdays or Sundays of any month.

The Grand Prize of the Aero Club of France, which is a cash prize of $20,000, has recently been offered for a cross-country aeroplane race next year. The conditions have not yet been announced.

Senator Henri Deutsch de la Meurth has recently offered a new prize of $14,000 for the encouragement of aviation. The conditions under which this prize will be competed for have not yet been drawn up.

The Automobile Club of Nice has donated $3,000 for aeroplane races, which will probably be held above the plains of Brague. These are vast level fields located about 10 miles from Nice. The series of races will be announced later.

The city of Paris has offered a prize of $3,000 for an aeroplane flight, the conditions of which have not yet been announced.

The city of Nice has given to the Aero Club of Nice the sum of $2,000 for an aeroplane race at Monaco next spring.

Various other prizes of $200 or more each have been offered for different special performances. These total about $4,200, some of them being as follows: Three prizes of $200 each to Frenchmen whose aeroplanes fly against the strongest wind for a period of five minutes, the prizes to be given on the 3d of January, the 2d of March, and the 3d of May next. Four prizes of $200 each to Frenchmen whose aeroplanes cover a circular kilometer when piloted by their owners, provided said owners have not previously won a prize of this amount. Three prizes of $200 each to the French owners of aeroplanes for the fastest speed over a kilometer made by their machines when piloted by their owners. The distance must be covered in both directions with a flying start. The machine may alight before making a return flight, but both flights must be made within fifteen minutes. These prizes will be given for the best performances up to the 3d of December, 1908, and the 3d of February and of April, 1909. The Goupy prize of $200 will be awarded to the aviator who covers the greatest distance across country in a straight line before the 3d of January, 1909. A speed of more than 40 kilometers (24.8 miles) an hour must be developed. A second prize of $400 has been donated by Bernhard Dubos for the best record of this kind made prior to March 3, 1909. A prize of $200 will be given to the aviator who, on the 3d of January, 1909, covers the greatest distance in a closed circuit without touching the ground, in a limited period of five minutes' duration. Another prize of $200 will be given to the French aviator who gets his machine in the air with the least difficulty on a specified track in starting and returning.

A number of other prizes have recently been donated, but the sums available are not stated. Some of these prizes are offered by the Company of Aviation for the first lady aviator who makes a flight in a closed kilometer; the Lazaire Weiller prize for the first French aviator who beats a record for height made by Wilbur Wright; the prize offered by La Vie Financière for the aeroplane having the smallest dimensions and showing itself capable of flight; the Arnoux prize for an aeroplane capable of flying above a French national highway bordered by trees, and landing on such highway after having made a flight of at least a kilometer; the André Falize prize for the first aviator who starts from the Invalides in Paris, circles around the Vendome column, and returns to its starting point; and the Siot-Decauville prize for the first French officer covering a kilometer in a closed circuit with his aeroplane.

In England several prizes have been offered for flights by aeroplanes.

The Brooklands Automobile Racing Association, about a year ago, offered a prize of $12,500 for a three-mile flight above the Brooklands automobile racetrack. The London Daily Graphic offered $5,000 for a flight of one mile at the Brooklands racetrack. Lord Montague, the proprietor of The Car, offered $2,500 to the owner of the aeroplane making the longest flight in England in any one year, as well as $25 a mile, up to 25 miles, for such flight.

The Adams Manufacturing Company offered $10,000 to the winner of the Daily Mail contest from London to Manchester, provided the entire aeroplane is constructed in Great Britain, while the Autocar offered $2,500 additional, provided the motor of the winning aeroplane was made in England.

America foots the list with donations for the encouragement of aviation, the only prizes offered being the SCIENTIFIC AMERICAN Trophy, which was presented to the Aero Club of America last year by the proprietors of this journal, the deed of gift stipulating that it should be competed for annually under rules which would be changed each year in order to keep abreast of the state of the art. If the trophy is won three times by any aviator, it becomes his personal property. Mr. Glenn H. Curtiss, of the Aerial Experiment Association, won it for the first time on July 4, 1907, by covering the required distance of a kilometer in a straight line, the actual distance of his flight being a trifle over a mile. The present flight required in order to win this trophy the second time is a distance of 25 kilometers (15 miles) in a closed circuit.

The only cash aviation prize of which America can boast is $100 offered by Mr. A. C. Triaca, of the International School of Aeronautics, for the longest flight in France or in America during the present year.

The above list of prizes makes it apparent why there has been so much progress in France this year in the development of the heavier-than-air flying machine. As soon as the American aeronautic organizations can show a list of cash prizes of a small fraction of the value of those which have been offered abroad, there will be an immediate response on the part of inventors in this country, many of whom are working hard at the problem, but are hampered by lack of funds. With cash prizes of a sufficient amount in view, these inventors will be enabled to raise money for necessary experimentation.

A METHOD OF MEASURING MUSCULAR WORK.

THE question of how we may measure the amount of fatigue of the human system by scientific methods, and observe its changes and degrees in the different professions is one of great practical importance. A series of researches in this field was undertaken not long since by Dr. Imbert, professor at the University of Montpellier, France. He wished to find how the efficiency of the human organism might be measured, considered as a motor. Up to the present, such researches were carried out in the laboratory, but Dr. Imbert wished to pursue a more direct investigation and so was led to consider the workman in his actual occupations in the shop, the field, etc.

The first results which are obtained in this way have a great practical interest. For instance, in the case of a workman who transports a load by wheelbarrow, the process of loading, pushing, and unloading causes an expenditure of energy. Different kinds of work naturally require various expenditures of energy, and it is the object of the researches to measure the amount of muscular fatigue, its variations and degrees in the different professions, and to treat experimentally the questions of equilibrium of expenditure of force and the rest which is necessary. These researches allow us to tell at what moment the human motor is fatigued and at what time rest is needed in order to secure fresh energy. This also has a bearing on accidents to workmen, for the accident takes place suddenly and the workman who is fatigued will not have the energy needed to make the movement rapidly enough which will put him out of danger. A non-fatigued workman may possess the needed energy for this purpose.

By measuring the energy of the human motor we can better direct its forces and utilize it to a greater advantage. It is of general interest not to deteriorate the human motor any more than in the case of a machine, and not to overwork it so that it cannot be restored by the usual amount of rest. The method which is used by Dr. Imbert for measuring the fatigue of the human system is of a simple kind. In the case of the wheelbarrow, which he selected in his first experiments, it is provided with a device which consists essentially of a spring or an elastic body whose deformations are transmitted to a recording drum. The spring and drum system should be placed between the point of applying the motive power by the hand or the foot of the workman, in the case of any kind of an appliance or tool, and the point of application of the resistance to be overcome. Such part of the appliance, as for instance the handle of the wheelbarrow, will be cut through and the spring placed between the two portions in order to receive the whole of the movement. The form and substance of the spring will be different for different tools, but the recording of the muscular effort is carried out on the drum in the same way. Dr. Imbert thus utilizes this method for obtaining a record of the different dynamic elements which it is necessary to observe when we wish to find exactly what is the work corresponding to a muscular contraction. By examining the curves which are recorded upon the registering drum we will obtain valuable data as to muscular work and fatigue which result from the use of the ordinary appliances or tools of the trades, and this will give a basis for disposing such work to the best advantage. For each kind of work it will show the highest amount of energy which can be reasonably demanded of the human motor without the risk of deteriorating it. We expect to give a complete account of Dr. Imbert's experiments and to illustrate the method which is used.

GAS TURBINES.

ACCORDING to a recent paper by Prof. G. Beluzzo in Elektrotechnische und Maschinenbau, the problem of the gas turbine is still far from solution. He divides these turbines into combustion and explosion turbines according as combustion takes place at constant pressure or at constant volume. Perhaps the only type which has given results of any practical importance is that of Armengaud-Lemale, which belongs to the combustion class, and has two speed stages. It is operated by a mixture of air and petroleum compressed to six atmospheres and ignited in a water-cooled chamber, and then expanded in a nozzle similar to that used by Laval. The exhaust heat is used to produce compressed steam, which acts on the wheels of the same turbine. The writer describes an 800-horse-power 4,000 revolutions per minute turbine of this type made by the Gesellschaft der Turbomotoren in Paris. The compressor has 22 wheels and is directly coupled to the turbine. The chief disadvantage of the gas turbine as compared with the reciprocating gas engine lies in the fact that in the former the compression takes place outside the machine, and, therefore, with reduced efficiency. The turbo-compressors hitherto constructed do not give more than 65 per cent efficiency, and at 4,000 revolutions per minute they give a pressure of seven atmospheres at most, while a much higher compression is necessary for a good thermal efficiency. Again, the cooling water which is required to protect the metal surfaces prevents the high temperatures being fully utilized. At the same time, the temperature attainable with the turbine is greater than with the engine, because the combustion takes place in a separate chamber without moving mechanism. In the Armegaud turbine a cast-iron combustion chamber with water cooling is used, and it is lined with carborundum. The writer discusses the further sources of loss, and by means of a numerical example shows that the theoretical combined thermal efficiency for a combustion type turbine is 0.294 and of an explosion type 0.31. Taking the highest practical results hitherto attained, however—viz., the efficiency of the compressor as 65 per cent and that of the turbine as 60 per cent—the thermal efficiency comes out at only 15 per cent and 21 per cent, and these figures are considerably lower than those attained with reciprocating gas engines. From further experiments on a small scale Prof. Beluzzo concludes that the gas turbine with more than one expansion stage could compete with the reciprocating gas engine if the compressor efficiency could be raised to 75 per cent and the turbine efficiency to 70 per cent.—The Electrical Engineer.

A GASOLINE-ELECTRIC FERRYBOAT.

A FERRYBOAT which is equipped on the gasoline-electric system is now in use upon the Seine, where the river has a great width not far from its mouth. There is no bridge over the Seine between Rouen and the channel coast, as it would be impossible to build a bridge here owing to the action of the tides and especially of the *mascaret*. In fact the tides are strongly felt all along the Seine as far as Rouen, and at the time of the great equinoctial tides, the *mascaret* would demolish any kind of construction which would be erected. The *mascaret* is a sudden tidal wave which forms a wall of water having often a height of 15 feet. It advances in the Seine with great impetuosity, sweeping everything before it, so that the boats are obliged to take refuge in the small bays which are arranged for the purpose. This wall of water advances at the rate of 25 miles an hour, and it diminishes gradually as it comes near Rouen. At different points on this part of the Seine ferryboats of various kinds are used. At Guilleboeuf a new ferryboat has been put into use which is one of the first of the kind on the Continent. The gasoline-electric system was adopted as the best suited to modern requirements.

The boat is a side-wheeler, and the two paddle wheels are mounted upon the same shaft. It was decided that there would be no advantage in mounting each wheel separately. Two electric motors, coupled to the shaft by means of reduction gearing, drive it conjointly. While the motors make 540 revolutions per minute the wheel shaft is driven at 30 revolutions per minute. The motors are of the iron-clad type such as is used for trackless trolley automobiles. Each motor is coupled to the gear set by means of a universal joint rod transmission so as to allow for the movements of the hull. Current for the motors is supplied by two De Dion gasoline engines and dynamo groups each of the 70-horse-power size. The groups run at the low speed of 550 revolutions per minute and furnish current at 220 volts for the electric motors. As for the gasoline motors, they are of the 4-cylinder 6 x 7.2-inch type with automatic carbureter. The cooling water is sent into radiating tubes which dip into the river and are placed on the sides of the boat. The motorman changes the speed of the boat by operating the controller, which is mounted in the circuit between the dynamos and the electric motors.

ELECTRICAL NOTES.

In the London Electrical Engineering is an article in which results are given of practical electric cooking in the Oxford Street branch of the Fleming restaurants of London. All the chops, steaks, poached eggs, etc., are cooked by electricity. The toasters and grills are built with the heating elements and a reflector above the food and with an asbestos pad above the reflector. The use of this type of grill has been much more satisfactory than the older kinds with the heat applied beneath. The cooking apparatus comprised a warming oven, a 1.8-kilowatt grill, a 600-watt egg poacher, a 5-gallon boiler, a small grill or toaster and a hot plate. The total consumption for eight days was 313 kilowatt-hours, or an average of 39.1 kilowatt hours. With power at 2¼ cents per kilowatt (1½d.) the daily cost was about 88 cents. This is an average of about 2 cents per hour for each appliance used. Actually the cost of running the egg-poacher, hot plate, etc., was about 1.5 cents per hour each, and for the large grill, capable of cooking twelve chops or steaks at once, the cost per hour was about 3 cents.

The first application of electric motors in steel mills was made about 1892, when they replaced steam-driven and other types of hoisting apparatus, and were also used for operating overhead cranes. The crane applications were of the greatest importance; no installation is considered modern without the electric crane, and no one who has had experience with it would think of replacing it by any other type. The application of electric motors was next made to the operation of charging machines for open-hearth furnaces and to machinery for the handling of blooms and slabs. Electric motors have also been used extensively for the operation of roller tables where ease of operation and time required in handling material is of the greatest importance. The application of the motor has also been extended to screwing down rolls of bloom, slab, plate, and other mills; lifting and rotating blast furnace bells; tipping Bessemer converters; operating transfer tables, saws, shears, bending and straightening rolls, blast furnace hoists, ore and coal conveyers, and all the auxiliary apparatus in iron and steel mills. In a few instances motors have been used for operating blowers for Bessemer converters, but in most cases blast furnace gases are used directly in gas engine driven blowers. For the purposes mentioned, either the direct or alternating-current variable-speed types of motors are universally used. This type of motor is suitable for developing speed at variable torque, and is applicable where frequent starting and reversing with large torque are required. Less energy is required to perform these operations with this type of motor than with other types.

In a paper presented to the Academie des Sciences, M. Mercadir describes his experiments in multiplex telegraphy which he carried out between Paris and Marseilles. He uses an apparatus which is an improvement upon his former multiplex instruments, employing the principle of alternating or undulatory currents. Several currents of different wave-lengths are superposed upon the line at the same time. The signals are sent by electro-magnetic vibrators or tuning forks and are received in "mono-telephones" or vibrating plates, each of which corresponds to the period of one of the vibrators, and therefore to a single period. Thus he forms a multiplex telegraph system, and the Morse signals are received in an ear-tube connected to each of the mono-telephones. He is able to place on the same wire the signals from no less than twelve electro-vibrators working at once, and the messages are taken by twelve mono-telephones. If necessary, he is able to use Morse registers as well as the telephones, and to do this he places over the telephone disk a very light and mobile lever which oscillates about an axis. One end rests in metallic contact on the disk. This lever is repelled when the plate vibrates under the waves sent from the electro-vibrator, owing to the very rapid vibrations, and it remains lifted up during the signal. This makes a contact for a local battery circuit through a Morse or Hughes register, using a sensitive relay if need be. Such a device M. Mercadir calls a "mono-telephonic relay." A first experiment made from Paris to Havre (150 miles) was very successful. Four Hughes receivers were used at each end of the line. But more recently he worked between Paris and Marseilles over a 540-mile line, and in this instance he used six Hughes instruments at each end, employing twelve mono-telephone relays in all, and thus exchanging twelve different messages upon the same wire at once. In each station there were six electro-vibrators and as many Hughes apparatus. Besides the present instruments which were using rotary currents, there were working on the line two other apparatus (Hughes or Baudot) which were using direct current and which were operated at the same time as the twelve vibrating instruments without interference. M. Mercadir states that there is no reason for limiting the number of instruments, and this may be greatly increased in future experiments.

ENGINEERING NOTES.

The electric drive of rolls, like the electric drive of hoists, started on the European continent. Electric drives are installed to replace old worn-out steam engines, and of course there is quite a noticeable gain. Besides, the rolling-mill engine has been sadly neglected, particularly the reversing type. All that was expected of it was that it should run and never break down, no questions being asked about steam economy. But times are changing and the builders of rolling-mill engines will have to pay greater attention to steam economies.

Some interesting experiments in aerial gunnery were recently carried out in Germany. From the basket of an ordinary balloon hand grenades with automatic fuses were hurled thirty feet at a painted target underneath, where they landed with a slight explosion. The experiments were designed to determine how accurately shells or other explosives could be dropped. The same balloon later dropped a couple of hand grenades with accuracy from a height of 780 feet. Photographs were taken in each case of the missiles' trajectory. It seems to be doubtful whether such accuracy can be attained at greater heights.

Eight specimens of crude petroleum from Bibi-Eibat examined by M. Rakusin, were found to be about twice as rich in "carbonized substances" as Balachany crude petroleum, and to approach in character the natural tars. The specimen obtained from the greatest depth (2,161 feet) had the sp. gr. 0.8700, and on fractionation yielded distillates which were dextrorotatory, and gave the same reaction with trichloracetic acid as specimens examined previously. With respect to the best conditions for the distillation of crude petroleum, these may be regarded as the more correctly chosen the greater the optical activity of the distillates and the lower the proportion of "carbonized substances" in the residue. The sp. gr., optical activity, etc., of further forty-seven specimens of Bibi-Eibat crude petroleum and their distillation products are given in a series of tables.

It is expected that the Master Car Builders' committee on car wheels will meet with representatives of the principal wheel manufacturers at an early date with the object of reaching a better understanding as to the need of better chilled cast iron car wheels, according to the Railway and Engineering Review. A letter has been addressed by the chairman of the committee to the car wheel manufacturers asking them to agree on a specification. Expressions of railroad representatives who have previously met the car wheel manufacturers in conferences indicate a disposition to specify a charcoal iron mixture. On behalf of the manufacturers it is continually urged that the first requisite to the improvement of the chilled car wheel is the payment by the railroads of a price which will permit the use of charcoal iron exclusively or charcoal iron and old wheels made from such iron. The committee on standard rail and wheel sections of the American Railway Association will soon meet to consider the wheel situation and determine what report it will make to the forthcoming semi-annual meeting of the association.

Some interesting links with the middle century, when the South of England was a prosperous iron-melting district, may be found to-day in Sussex. Although iron ore is found abundantly in this area, there is an entire absence of fuel for smelting purposes, and it was the close proximity of the two minerals to one another in the North of England that brought about the removal of the industry to that more convenient area; so that the Sussex iron trade fell into desuetude. Throughout the county may be found scattered large expanses of water called "hammer ponds," from the simple fact that in the iron-smelting days, the water constituted the motive power for driving the ponderous hammers by means of which the ore was pounded or the iron smelted. They are still known under their original name. In many cases they were simply formed by damming back the water in the rivers, which was a comparatively easy matter, since the majority of the Sussex waterways flow between deep banks. In close proximity to these ponds may be seen traces of the long since abandoned industry in the iron workings and remains of furnaces. At Buxted there is still pointed out a dwelling in the village known as "Hog's House," which is reputed to have been the residence of Ralph Hogge, who claims to have been the first man to have cast a metal cannon in England in this village, but this is probably a mistake, since records point to the fact that the first gun was made at Eridge, some miles to the east, at a forge the site of which is occupied by the signboard standing in the midst of a small green beside the road, carrying the sign of the "Gun Inn" in perpetuation of the interesting foundry achievement there carried out. These hammer ponds fulfilled a dual purpose. In addition to driving the hammers they constituted the fish preserves of adjacent monasteries, the supplies of which food were obtained from these waters.

TRADE NOTES AND FORMULÆ.

Black Color for Mourning Stationery.—In its production add, to a solution of 500 parts of gum arabic, 40 parts of bichromate of potassium and then introduce the quantity of ivory black required to produce the desired depth of color. To prevent the cracking of the mixture it may be mixed with some glycerine.

Eureka Renovator (Spot-removing preparation).—50 parts of white olive oil soap are dissolved, in the water bath, in 4,000 parts of water, 7 parts of oil of wintergreen are dissolved in 50 parts of alcohol and these solutions thoroughly mixed by shaking them up together.

To Clean Precious Stones When Dimmed and Dirty.—This is best effected by means of milk of sulphur, i. e., wet, precipitated sulphur moistened with alcohol. A mixture of 1 part of washed flowers of sulphur and 2 parts of fine washed tripoli powder is also adapted for this purpose. The mixture, by means of a soft leather, is rubbed on the precious stones. Places that are not accessible by means of the chamois can be treated with a small brush, a second brush being employed to remove the dust. If the gems are set in silver the sulphur must be omitted.

Extinguishers (Hand fire grenades).—I. 2 parts of chloride of ammonia in 200 parts of water. II. 3½ parts of burned alum and 100 parts of water. III. 30 parts of sulphate of ammonia in 50 parts of water. IV. 20 parts of common salt in 400 parts of water. V. 3½ parts of sodium carbonate in 50 parts of water. VI. 45 parts of soda water-glass. These fluids are mixed together in the order quoted and should the mixture appear milky or yellowish, a further 200 parts of water may be added. The solution is allowed to stand, the supernatant, clear portion being used.

Artificial Rubber.—A German contemporary gives the following: In an iron kettle, place about 5 parts of sulphur or flowers of sulphur and 10 parts of rapeseed oil and heat the mixture, stirring constantly, until the sulphur is melted and until finally the mixture puffs up; at this stage it must be quickly poured out, if possible, into a mold that has been dusted with some kind of flour or on the stone slabs moistened with water, on which it immediately hardens. It possesses properties similar to rubber and is also re-soluble in oil.

Wilkinson and Peters publish the following method of determining whether milk has or has not been heated: To 10 parts of the milk add 2 parts of a 4 per cent alcoholic solution of benzidin, 2 parts of a 3 per cent solution of hydrogen dioxide, and a drop or two of acetic acid. A blue coloration is instantly produced in raw milk, but not in mik that has been heated above 173 deg. F. In mixtures of raw and cooked milk, 15 per cent of raw milk gives a distinct, and even 10 per cent a faint blue coloration; but the addition of 5 per cent of raw milk cannot be detected. If the hydrogen peroxide is omitted, the process may be used to detect the presence of that substance in the milk.

Imperishable Legends for Druggists' Bottles.—In the preparation of these inscriptions an etching or corroding fluid is made use of, which is made as follows: Fluid I. 36 parts of fluoride of sodium are dissolved in 500 parts of distilled water and to this is added 7 parts of sulphate of potassium. Fluid II. 14 parts of chloride of zinc are dissolved in 500 parts of distilled water and 50 parts of concentrated hydrochloric acid added to it. In using it, mix equal parts of both fluids together and add a little dissolved India ink, in order to make the writing more readily legible. The mixture must not be effected in a vessel, but it is best to take a cube of paraffine, in which a depression has been made, for the purpose. With this etching fluid it is also possible to write names, etc., on window panes.

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